

Crime and Poverty in the Kingdom of Bavaria during the Period 1835/36 – 60/61

Property crime, violent crime, and rye prices

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Preface

This paper is written under a scholarship from the research centre ESOP (Equality - Social Organization – Performance). ESOP is funded by the Research Council of Norway as a Norwegian Centre of Excellence at the Department of Economics.¹ I am particularly grateful to Halvor Mehlum, my supervisor, for his inspiration and expert assistance throughout the writing of this paper. Mehlum works as a Professor in Economics at the University of Oslo. Mehlum has Development Economics as his particular field and he is employed at ESOP. He was kind enough to lend me his copy of the book written by Georg Mayr, the most important statistical source for the writing of this thesis, as well as the empirical workings from the article which was written on the same topic by himself and two of his colleagues. He has also been very helpful in guiding me in the right direction as to where to search for supplementary data and relevant background material for the writing of this thesis. I am also grateful to Erik Bjørn, Professor in Economics at the University of Oslo, with Econometrics as his particular field, for sorting out some of my technical uncertainties.

I further want to thank the librarians at Statistics Norway for their help in going through their files in search of relevant statistical documents from the Kingdom of Bavaria in the period 1835/36 – 60/61. I also want to thank the librarians at The Bavarian State Office for Statistics and Data for answering my questions concerning the financial year in Bavaria then and now.

With regard to the final preparation of the manuscript, I also thank my family and friends for helpful comments and suggestions.

¹ <http://www.esop.uio.no/>

Abstract

My main objective in this paper is to evaluate how poverty was related to property crime and violent crime respectively in the Kingdom of Bavaria in the period 1835/36 – 60/61.

My point of departure is the book *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*, written by the German statistician Georg Mayr (1841 – 1925) and published in 1867. Mayr was employed at the Bavarian Statistical Bureau when the book was published. He was appointed Director of the Bureau two years later.

Mayr paid attention to the seven administrative regions Upper Bavaria, Lower Bavaria, Upper Palatinate, Lower Franconia, Middle Franconia, Upper Franconia and Swabia during the period 1835/36 – 60/61. I also limit my paper to the same seven administrative regions as Mayr did in his book.

What makes the analysis by Mayr particularly valuable is that he divided crime into different categories and looked at how poverty, then measured in terms of the rye prices, affected different types of crime. His main empirical findings were that higher rye prices tended to lead to more property crime (where theft was the dominant subcategory), but less violent crime (mainly consisting of injuries and rape).

I further consider the article *Poverty and crime in 19th century Germany* written by Mehlum, Miguel and Torvik and published in the Journal of Urban Economics in 2006. The authors use much of the same data as Mayr did in his book, but they make a twist in the analysis, using rainfall as an instrumental variable for the rye prices. They also give a different explanation of why higher rye prices tended to give less violent crime in the Kingdom of Bavaria at that time, namely that higher rye prices yielded higher beer prices and thereby less alcohol consumption, which again gave less violence. Mayr on the other hand simply argued that the different types of crime had different motives; whereas simple theft was driven by distress, the violent crime was a result of crudity and passion.

Although the beer prices may very well be important to correct for in the regression analysis, one cannot claim that higher rye prices led to higher beer prices for the period in question, due to the Reinheitsgebot, a food quality regulation from April 23rd 1516. This Bavarian Purity Law said that the only ingredients allowed to use in beer were barley, hop, and water.

After having found supplementary data, I calculate that the correlation coefficient for the barley and beer prices for the period 1835/36 – 60/61 is + 0.69 and thereby somewhat higher than the correlation coefficient for the rye and beer prices, which is + 0.64. That the former is larger than the latter is as expected, since beer was made with barley and not with rye. Interestingly, the correlation coefficient between the rye and barley prices is as high as + 0.95. So even if it was the barley prices that caused the higher beer prices and not the rye prices, at a first glance it still seems possible (since the rye prices and the barley prices were so highly correlated) that *the reason why the rye prices and the violent crime were negatively related to each other was that beer was now more expensive, leading to lower alcohol consumption, and therefore people were less violent*. I then exchange the rye prices with the beer prices in the data set which Mehlum et al use and I find that the variable for the beer prices is statistically significant in the regression for violent crime, even at the 1 % level. A 1 % change in the beer prices is associated with a - 0.9 % change in violent crime, so this effect is significant in every meaning of the word.

I further look into *why* the rye prices were so high in 1846/47 and 1853/54. When considering the workings of poverty in these years, one should both look at what caused the poverty and what possibilities the inhabitants had to escape the situation. Friedrich B.W Hermann, of whom Mayr was both a student and a successor to the seat at the Bavarian Statistical Bureau, wrote that after a period with constant grain prices, the reason why the prices fluctuated was the quality of the harvest; *bad harvests led to high prices and good harvests to low prices, where less than average was produced in the former case and more than average in the latter case*. The book by Hermann has been informative as to why the Kingdom of Bavaria experienced the years of high prices, but it has also shown that research on agricultural production was scarce in this period, and one should therefore be very careful with the utilization of these data. The data at hand are mainly average values and are also to some degree based on guesses.

I create a panel data set in an Excel-sheet and run *two main regressions* in STATA, one with violent crime and one with property crime as the dependent variable. The panel data set further contains variables on the rye prices, beggary, vagrancy, mortality, fertility, emigration and the adult male to female ratio. It differs from the data set created by Mehlum et al both by including different explanatory variables and also by including the rye prices for each region rather than using one single Bavarian rye price series. I expect the fluctuations for the rye prices, beggary, and vagrancy to be larger *within* the administrative regions than

between them. The within estimator (the fixed effects estimator) should therefore be used. By plotting the dependent variable against the different explanatory variables separately, I also find a linear specification to be the most appropriate. I run two supplementary regressions in STATA, where I first consider beggary and then vagrancy to be the dependent variable. For all four equations I correct for heteroskedasticity and cluster by years, which Mehlum et al also correct for in their regression analysis. Clustering by years corrects for the possibility that the error terms are correlated between the regions within the same year. The main reason for expecting this is that the omitted variables may work in the same direction in all the seven regions.

In the regression where I consider property crime as the dependent variable, I find that the variable for the rye prices has a moderate *positive* effect, which is statistically significant even at the 1 % level. The elasticity of property crime with respect to the rye prices is 0.24, so that an increase in the rye prices of 1 % leads to an increase in property crime of approximately 0.24 %. Further, when the rye prices increase with a one standard deviation, there is an increase in property crime of an approximate 0.48 standard deviation. Mayr argued that theft was more common when it became more difficult to obtain food legally and that one naturally could conclude that property crime would increase with food scarcity. That these tendencies really were seen in Bavaria at the time is supported by my own empirical findings.

The variable for the rye prices further has a moderate *negative* effect on violent crime, also statistically significant at the 1 % level. An increase in the rye prices of 1 % leads to an increase in violent crime of approximately 0.20 %. When the rye prices increase with a one standard deviation, there is an increase in violent crime of an approximate 0.2 standard deviation. I will stress two possible explanations (of course there could be many more) of why there was a tendency for poverty to affect violent crime negatively in Bavaria in the period 1835/36 – 60/61. The first possible explanation is that in poor times the Bavarians were too exhausted by and too preoccupied with covering their most basic needs such as food and shelter to commit any violent crime. This is also how I believe Mayr (his explanation was somewhat unclear) saw the link between poverty and violent crime. The second explanation is the one which Mehlum et al present in their article. Since I find that the variable for the rye prices is statistically significant even at the 1 % level (and since the rye prices are so highly correlated with the barley prices and since barley was an important

ingredient in the beer) I do not reject their way of reasoning, but I leave it out of the rest of my analysis.

The variable for the rye prices is statistically significant both in the regression where I consider beggary and in the regression where I consider vagrancy as the dependent variable, both times even at the 1 % level. Mayr assumed that the rye prices would show an even more intensive effect on these variables. By looking at the elasticities, this is supported by my empirical findings; an increase in the rye prices of 1 % leads to an increase in beggary of approximately 0.56 % and to an increase in vagrancy of approximately 0.51 %. I might have an endogeneity problem in both these regressions, though, due to the poorer health of beggars and vagrants, which might affect both fertility and mortality. Then I must exclude these variables, and since I already seem to have a severe omitted variable bias, not much explanatory power is left.

One has to be aware of the danger of the so-called “ecological fallacy” when interpreting the data; *a logical fallacy inherent in making causal inference from group data to individual behaviors*. This is exactly what I find to be the main problem with Mayr’s way of reasoning, although he certainly *did* point out that the statistician could only look into possible causal chains as long as these could be supported scientifically by connecting data on crime with data on factors that influence crime.

We may speak of tendencies on the aggregate level and then say what we find to be a possible relationship on the individual level. This is exactly what I have done in this paper. There are *tendencies* in the data, showing that in poor years, there was on the one hand less violent crime and on the other hand more property crime and more beggary/vagrancy in the Kingdom of Bavaria during the period 1835/36 – 60/61.

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1. Introduction

Researchers from different fields have for a long time been interested in the link between crime and the economic welfare. Certain crimes are committed in need, among them simple theft. This is exactly what many researchers have wanted to look deeper into and the food prices have been of particular interest in this regard.²

My main objective in this paper is to evaluate how poverty was related to property crime and violent crime respectively in the Kingdom of Bavaria during the period 1835/36 – 60/61.³ My point of departure is the book *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*, written by the German statistician Georg Mayr and published in 1867.

The two main reasons why I wanted to write this paper was (i) to have a closer look at the link between poverty and crime and (ii) to evaluate the techniques and the way of reasoning used by a statistician writing in the early days of statistics, both by looking at *more* data and by using modern software tools.⁴

Statistical documents were first systematized in the 19th century. The Bavarian Statistical Bureau was founded in 1833, only two years before the beginning of the period I am looking at. Statisticians from around Europe had their first gatherings in the second half of the nineteenth century, where they emphasized the growing importance of statistics. The very first Statistical Conference took place on September 11th in the year 1853 in Brussels and here it was stressed that one should try to unify the forms and language of statistical documents so that they easier could be compared. Official representatives from a number of

² Wladimir S. Woytinski: "Kriminalitet und Lebensmittelpreise", *Zeitschrift für die gesamte Strafrechtswissenschaft* 49 (1929), pp. 647 – 675, part. p. 648

³ The financial year at the time was from October 1st to September 30th, i.e. the year 1835/36 describes the period from October 1st 1835 to September 30th 1836.

⁴ I create a panel data set in Excel and run my regressions in STATA.

Governments, among them both Norway and Bavaria, gathered and it was shown that in most the principal countries of Europe general statistical departments had been established.⁵

My data set contains data from both Mayr's book and from other publications by the Bavarian Statistical Bureau. It was only possible to create this data set exactly because of the growing interest for statistics, leading to a collection of data on many important variables on an annual basis. Writers from the field of Development Economics have stressed the value of further research on different types of poverty measures and on agricultural statistics. Going through statistical writings of the 19th century has shown me that the importance of knowledge on these issues was stressed already then. Mayr was modern in his view to emphasize the necessity of considering the *fluctuations* in the data, whereas other economists writing at his time only worked with snapshots of the economy or with average values.

What makes the analysis by Mayr particularly valuable is that he divided crime into different categories and looked at how poverty, then measured in terms of the rye prices, affected different types of crime. His main empirical findings were that higher rye prices tended to lead to more property crime, but less violent crime. *Bavaria was a poor agricultural society at the time and rye was a crucial part of nutrition for the Bavarians.* Periods of high rye prices were therefore considered to be periods of poverty. The rye prices were particularly high in 1846/47 and in 1853/54.

Mayr paid attention to the seven administrative regions Upper Bavaria, Lower Bavaria, Upper Palatinate, Lower Franconia, Middle Franconia, Upper Franconia and Swabia during the period 1835/35 – 60/61. Today one would say that this is a short period when looking at a data set, but frequent investigations were rare at the time, and this data set is in spite of its limitations of great value. Mayr avoided a comparison with the province Palatinate, which belonged to the Kingdom of Bavaria at the time, since the data collection and the definitions here were different from the other regions. I also limit my paper to the same seven administrative regions, so whenever I refer to *the Kingdom of Bavaria*, I mean the area covering these seven administrative regions. The developments in the Kingdom of

⁵ Leone Levi: "Resume of the Statistical Congress, held at Brussels, September 11th, 1853, for the Purpose of Introducing Unity in the Statistical Documents of all Countries", *Journal of the Statistical Society of London* (1854), Vol.17, No.1, pp. 1 – 14, part. pp. 1- 3

Bavaria were in many aspects determined by the developments in other German parts and in Europe. Still, the population in Bavaria didn't like to be influenced by outer areas and the Bavarians were described as traditional, with strong family ties. The Kingdom of Bavaria was therefore not as strongly affected by the outer changes.⁶

I will not do a comparison between different countries, since it is more valuable to go in depth in a paper such as this one. 19th century Germany is also hard to define geographically, because of the large political upheavals that took place in Europe at the time, changing the map considerably. Also, as I have already mentioned, it was only towards the end of the period I am looking at that representatives from different parts of Europe began to stress the importance of unifying the forms of the statistical documents, making a comparison across the borders in the period 1835/36 – 60/61 difficult.

Mayr wrote *about his own time* and therefore not with a historical perspective. His book was published only a few years after the end of the period he was looking at and he can in my view therefore not be blamed for the lack of emphasis on important background knowledge, such as *the degree of poverty* in the years of high prices. He might have expected the reader to be familiar with the economical situation in these years and to some degree also with how the quality of the harvests and the rye prices interacted. Even if he did *not* expect the reader to know much of this, his colleague and at the time Director of the Bavarian Statistical Bureau, Friedrich B. W. Hermann, had published a book on *harvests* the previous year, which might explain why Mayr himself did not evolve further on this topic. Hermann held the position as a Director during the rest of his life and the establishment of the Bureau was mainly his work. Mayr was a student of his and the successor to his chair at the Bavarian Statistical Bureau.⁷ It is in hindsight interesting to view the writings of these two German statisticians together.

I will further consider the article *Poverty and crime in 19th century Germany* by Mehlum, Miguel and Torvik, published in the Journal of Urban Economics in 2006. The

⁶ Bayerisches Statistisches Landesamt: *Bayern im Lichte seiner hundertjährigen Statistik.. Heft 122 der Beiträge zur Statistik Bayerns*. (München: 1933), p. 2

⁷ Heinz Kurz: "Friedrich Benedikt Wilhelm Hermann on capital and profits", *The European Journal of the History of Economic Thought* (1998), Vol.5, No.1, pp. 85 – 119, part. pp. 86-87

authors use much of the same data as Mayr did, but they make a twist in the analysis, using rainfall as an instrumental variable for the rye prices. They also give a different explanation of why higher rye prices tended to give less violent crime in the Kingdom of Bavaria at the time, namely that higher rye prices yielded higher beer prices and less alcohol consumption, which again gave less violence. Mayr on the other hand simply argued that the different types of crime had different motives; whereas simple theft was driven by distress, the violent crime was a result of crudity and passion.

In this paper I have to take into consideration that I am looking at a data set from the 19th century and therefore might not have data on all the variables that we would control for today. Still, since Bavaria was a poor agrarian society at the time, the analysis does not have to include as many variables as it would need to in the complex economy of the modern world. I have tried to make the best possible use of the data at hand. I have gone through several publications by the Bavarian Statistical Bureau in the search of data on important variables. My data set contains variables on which I have been able to find numerical values for each year and each region (or make reasonable estimations of the lacking numbers). For many variables we are unfortunately only given data on average values or snapshots of the economy, which is why they could not be included in my analysis.

2. Placing Bavaria on the map⁸

I = Oberbayern = Upper Bavaria

II = Niederbayern = Lower Bavaria

III = Pfaltz = (Rhineland) Palatinate

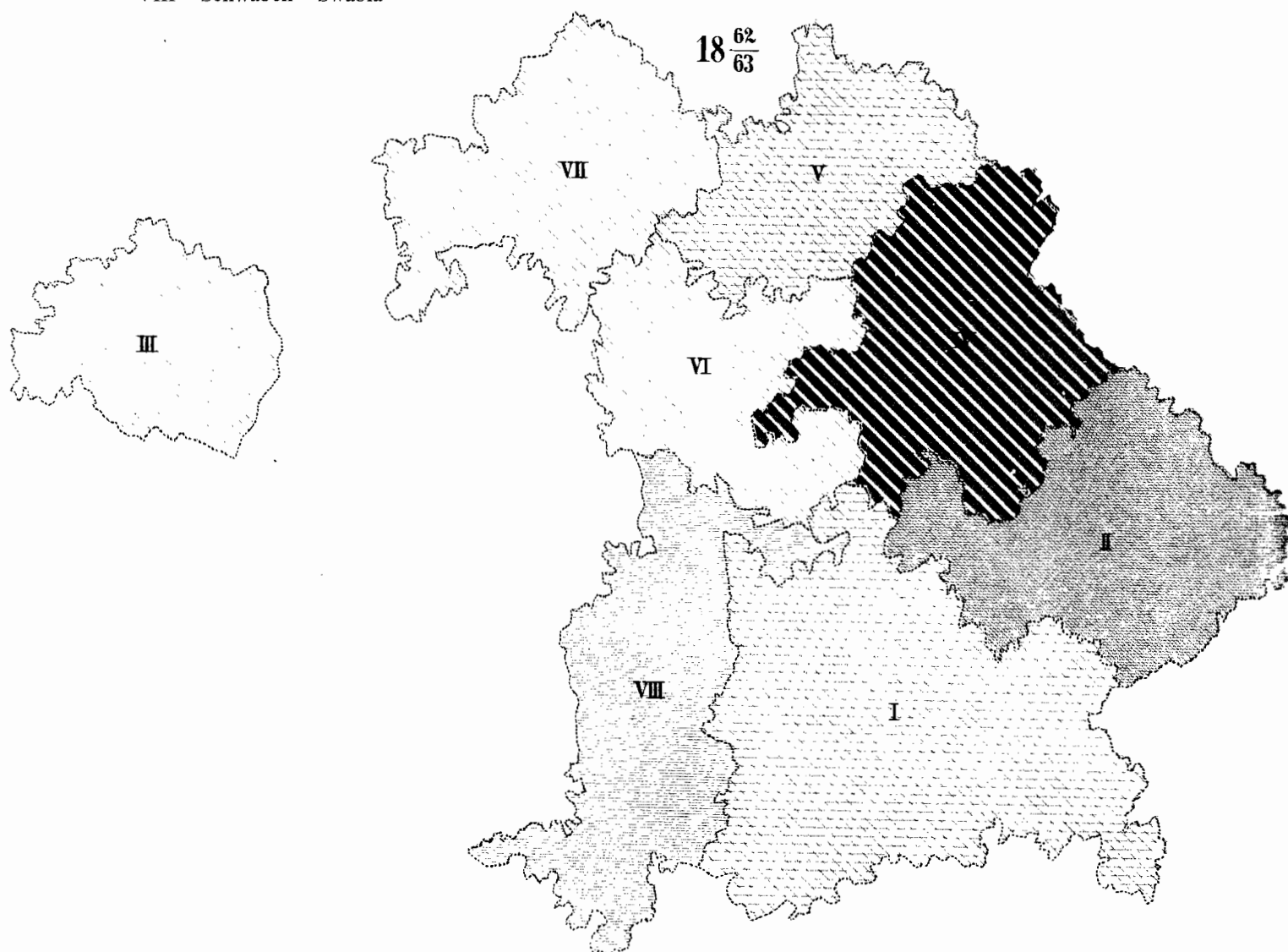
IV = Oberpfaltz = Upper Palatinate

V = Oberfranken = Upper Franconia

VI = Mittelfranken = Middle Franconia

VII = Unterfranken = Lower Franconia

VIII = Schwaben = Swabia



⁸ Georg Mayr: *Ergebnisse der Strafrechtspflege im Königreiche Bayern. XIX. Heft der Beiträge zur Statistik des Königreichs Bayern.* (München: 1868).

The map of the Kingdom of Bavaria is from 1862/63, i.e. shortly after the period I am looking at. It is the area *around* the seven administrative regions that has gone through large changes since then, rather than the area of the regions itself. The Kingdom of Bavaria in the period 1835/36 – 60/61 thereby coincides with Bavaria as part of Germany as Germany is today. The map is of interest both to see where the regions are situated in relation to each another and to give an impression of the relative sizes of each of the seven administrative regions.

The Kingdom of Bavaria was not well-defined as an area before after the Napoleon wars.⁹ It then consisted of the administrative regions Upper Bavaria, Lower Bavaria, Upper Palatinate, Lower Franconia, Middle Franconia, Upper Franconia and Swabia. In addition, the area Rhineland Palatinate (or simply Palatinate) was a province that belonged to Bavaria, but that was judicially and administratively different from the seven other administrative regions. One should not confuse the name Upper Palatinate with Palatinate. Upper Palatinate was made a part of Bavaria already in the 17th century. Palatinate, on the other hand, was not annexed to the Kingdom before 1815.

⁹ Bayerisches Statistisches Landesamt: *op.cit.* p. 1

3. Previous research

3.1 Georg Mayr and the Bavarian Statistical Bureau

The collection of statistical data in Bavaria started already in the 18th century. The first publications of criminal offences in Bavaria are however from the early years of the 19th century. The Government originally started making statistics on reported crime public so that everyone could get acquainted with and could reflect upon how the law worked. In the following years one became more inclined to publish statistics on reported crime with the intention to say something about “the public safety” in Bavaria.¹⁰ The statistical data from the Kingdom of Bavaria were however not systematized before the foundation of the Bavarian Statistical Bureau in 1833.¹¹

Georg Mayr (1841 – 1925) was employed at the Bavarian Statistical Bureau when his book *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern* was published in 1867. He was appointed Director of the Bureau two years later.

In his book from 1867 Mayr wanted to assess the seven administrative regions in the Kingdom of Bavaria separately and together, but avoided, as already mentioned, a comparison with Palatinate because of the large discrepancies in how data were collected. He worked with a data set from the period 1835/36 – 60/61 and stressed the large value of the frequent investigations over the long period. The data were mainly taken from *die gerichtliche Polizei*.

Mayr made the point that statisticians often considered longer time periods simply to look at the average values. He stressed that an average value however could be a result of both small and large fluctuations. Mayr rather wanted to consider the fluctuations in the data over the period in order to explain *why* the crime rate fluctuated and to look more

¹⁰ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. XVI. Heft der *Beiträge zur Statistik des Königreichs Bayerns*. (München: 1867), p. 5

¹¹ Bayerisches Statistisches Landesamt: *op.cit.* p. 1

specifically into larger deviations. He wished to show that the fluctuations in different types of crime followed certain regularity and that using data from these fluctuations, rather than the average values, could help explain why a crime was committed in the first place. Some connections could according to Mayr not be denied, such as the immediate influence that access to nutrition had on the crime rate.¹²

Mayr further stressed how unfortunate it was that many statisticians focused on the number of *sentenced criminals* in stead of on the crime itself. He himself looked at data on reported crime, which he believed was the best way to measure criminality. He warned that data on reported crime did not always give the number of crimes actually committed. Mayr pointed out that on the one hand minor thefts and abuse of a less severe type were not always reported and on the other hand some crime incidences were falsely reported (where he assumed that the number of crimes *not* reported was likely to exceed the number of incidences *falsely* reported). Still, Mayr pointed out that one should not underestimate the value of the data at hand; one could not expect the police to be omniscient and had to be prepared for lacking numbers. He assumed that the relationship between reported crime and real crime was stable and that the fluctuations in the first indicated fluctuations in the latter. More importantly, when assessing the value of the data was according to Mayr how they were divided; it was crucial to separate between different types of crime, or else the material would have no value.¹³

Data on violations of the public order and safety were divided into three main categories for the period in question:

- 1) **Crime and Offences against the State** (such as high treason, defamation of the Royal family, forgery of money)

- 2) **Crime and Offences against the Private Person** (including property crime and violent crime)

- 3) **Minor Violations of the Law** (including beggary and vagrancy)

¹² Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. *op.cit.*, preface

¹³ *ibid.*, p. 2

I will solely consider the latter two main categories in this paper.

The definition of violent crime in this paper includes injuries, rape, illegal imprisonment, abuse, and kidnapping, where injuries constitute the largest and rape the second largest part. Note that by violent crime I refer to what Mayr defined as “Angriffen gegen die Person” (*attacks against the person*) and I do not include “Angriffen gegen das Leben” (*attacks against life*, which include murder, attempt of murder, abortion etc). For “Angriffen gegen das Leben” the fluctuations do not occur with the same regularity as they do for “Angriffen gegen die Person”. For the former category, there is less variation and an increase in one region is seen simultaneously with a decrease in another. For “Angriffen gegen die Person”, on the other hand, fluctuations are similar across the regions. I have called “Angriffen gegen die Person” *violent crime* for short, but the reader should then be aware of the fact that I do not include all types of violence here.

Property crime includes violations such as theft, embezzlement, blackmail and robbery, where theft clearly is the dominant subcategory. Mayr found that property crime was the most common type of crime in the Kingdom of Bavaria during the period 1835/36 – 1860/61, constituting three fourth of the total crime rate.

The separation between *beggars* and *vagrants* could, according to Mayr, not always be performed with extreme sharpness; nevertheless, beggary concerned a *more settled part* of the population, with individuals on an income level lower than sufficient for basic nutrition and therefore trying to increase their income through voluntary gifts from others without emigrating from their homeland. For the majority of vagrants, however, Mayr explained that it was first of all the wandering around that formed the very beginning of a similar procurement of the life requirement.¹⁴

Mayr wrote that it was not the task of the statistician to look into all the possible explanations of why a person decided to commit a crime; this was rather a task for the field of psychology. The statistician could however look into possible causal chains as long as

¹⁴ *ibid*, p. 127

these could be supported scientifically by connecting data on crime with data on factors that influenced crime.¹⁵

Mayr found it important to take the size of the population, age, and gender into consideration. He looked at the number of reported crime per 100 000 inhabitants for each year and each region. According to Mayr very few people committed a crime before the age of 14. He stated that the results clearly depended on dividing the population in those below and above the age of 14, by showing that the differences between the administrative regions now were made smaller. Mayr further argued that one had to consider the gender ratios in the population. The data were here taken from *die Rechtspflege*, rather than from *die gerichtliche Polizei*.¹⁶ Mayr pointed out that there in general were less female than there were male criminals; he found the relationship to be around 1:5 (sentenced females per sentenced males) for the whole period. When both age and gender were taken into considerations, Mayr claimed that crime no longer varied so much geographically.¹⁷ When making his argument that it was important to take the age and gender distribution into consideration, Mayr first only provided the reader with the total number of criminals per 100 000 inhabitants in each region for the whole period, before and after correcting for age and gender.

Mayr then considered the effect of correcting for the age and gender distribution also when looking at fluctuations in time. He provided five year averages for the age ratios (the number of inhabitants over the age of 14 per 100 inhabitants) and numerical values for every fourth year on the number of females above the age of 14 per 1000 males above the age of 14. He found that the changes in the age and gender ratios within a region were not as considerable as the differences between the regions when looking at the average values, so that an analysis could be based *on the same age and gender ratio* for the whole period.¹⁸

Mayr further wrote that one had to consider how religion affected crime. Mayr provided the reader with average values for the number of people belonging to different

¹⁵ Georg Mayr: "Moralstatistik mit Einschluß der Kriminalstatistik" *Statistik und Gesellschaftslehre. Band 3* (Tübingen: Mohr, 1917)

¹⁶ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern. op.cit.*, p. 21

¹⁷ *ibid*, pp. 22 - 25

¹⁸ *ibid*, pp. 39 - 40

religions only for the year 1852, comparing these values with the average number of reported crimes per 100 000 males over the age of 14 for the whole period. He did not find any clear connections here, but noted that Upper Franconia and Middle Franconia, who had the highest share of Protestants, also had the lowest share of criminals.¹⁹

Mayr stated that married life had a considerable influence on the morality in the population. He presented the reader again only with data from 1852 when reaching this conclusion, showing that Upper Franconia and Middle Franconia, which had the most favorable data on crime, also had the relatively largest number of married people. Mayr stated that the data from *die Rechtspflege* clearly showed that the unmarried life led to criminality, since those who were married much more seldom committed a crime than those who were not.²⁰

Even though Mayr stressed the value of looking at fluctuations in the data he himself only provided the reader with average values or snapshots of the economy for the variables age, gender, marriage, and religion, before making rather strong assertions. Reserved different types of crime alone, Mayr scrutinized the fluctuations in the data. (It might of course be the case that Mayr performed calculations using more detailed data on his own and that his conclusions were based on these not published calculations.)

Mayr pointed out that violent crime was at its lowest in the year of high prices 1846/47, but at its highest in the last year of the period. Property crime was most frequent in 1846/47 for Upper Bavaria and Upper Franconia and for the area “on this side of the Rhine” seen as a whole (meaning the eastern side of the Rhine and thereby including the seven administrative regions, but excluding Palatinate). For the regions Middle Franconia, Lower Franconia and Swabia the highest rate of property crime was found in 1853/54, another year of high prices. In Upper Palatinate the highest rate was found in the following year. Only in Lower Bavaria he found that the highest frequency of property crime was *not* in a year of high prices, rather in the last year of the period (the year 1860/61). Otherwise it was *generally so for the period in question that the rate of simple theft decreased when the rye*

¹⁹ *ibid*, p. 29

²⁰ *ibid*, p. 30

prices decreased. The exception here was according to Mayr the professional thief, who of course did not ask for the grain prices.

For the Kingdom of Bavaria seen as a whole, the property crime was most frequent in the years 1846/47 and 1853/54, whereas the number of violent crimes increased considerably in the latter years of the period 1835/36 – 60/61. Crime and offences against the State also increased in the latter years and thereby also the total crime rate.

*Mayr claimed that when evaluating the fluctuations in property crime up against fluctuations in violent crime one immediately found the constant relationship of an increase in the former and a decrease in the latter, and vice versa a decrease in the property crime and an increase in the violent crime and according to Mayr one could not deny a certain regularity of this fact.*²¹

Mayr explained this phenomenon with different motives; violent crime mainly consisted of injuries and rape, crimes which he believed were driven by crudity and passion. In the period 1835/36 – 1860/61 property crime mainly consisted of thefts, the main motive of which Mayr considered was to satisfy the most basic needs; starvation and hunger. Theft was more common when it became more difficult to obtain food legally. Mayr further wrote that one naturally could conclude that property crime would increase with food scarcity.

Mayr divided food scarcity in 1) *subjective food scarcity* (reduced personal income) or 2) *objective food scarcity* (considerably higher food prices). He stressed the fact that the objective food scarcity appeared simultaneously for all the individuals, whose income hardly covered the bare necessities. *There was, according to Mayr, no more general food scarcity in this sense than when the grain prices increased.*

Mayr expected there to be a negative relationship between violent crime and poverty. The interpretation of this relationship may seem superficial, simply saying that different crimes had different motives. Mayr further wrote that a quick look at the graphical illustrations immediately showed the exact connection between the fluctuations in property

²¹ *ibid*, p. 41

crime and the fluctuations in the rye prices, the curves then being surprisingly parallel, whereas violent crime moved in the opposite direction of the rye prices.²²

Mayr also stressed the need to take into consideration the effect that the rye prices had on emigration and which effect this emigration further had on crime. He claimed that food scarcity would lead some people to emigrate and that criminality would decrease when people in distress wandered out. Mayr referred to the graphical illustrations to see the interaction between the rye prices, emigration, and property crime; property crime was more frequent in 1846/47 than in 1853/54, even though the rye prices were higher in the latter years; the emigration was however twice as large in 1853/54 as it was in 1846/47.²³

Since Upper Bavaria had the most crime out of the seven administrative regions in the period 1835/36 – 60/61, also when correcting for the age and gender distribution in the region, Mayr found it to be of particular interest to look at how crime fluctuated here. Upper Franconia formed the other extreme with the least crime.

In the latter three years of the period, the number of crimes and offences increased considerably, both for violent crime and for property crime. Mayr alleged that the violent crime increased because there was easier access to food, both objectively and subjectively; the grain prices were moderate and the wages increased considerably all over.²⁴ That theft became more common in these years could however *not* be seen together with the grain prices (since the grain prices were relatively low in the latter years of the period). Mayr reasoned that a sudden change in the righteousness of the population was also unlikely. He declared that the change probably rather was due to how the population was put together; Upper Bavaria had the lowest rate of emigration and Mayr maintained that the population therefore to a larger degree consisted of people inclined to commit a crime. Even more importantly, not only did few criminals wander out of Upper Bavaria, many people moved *to* this region from the other administrative regions as well and then mostly men in the age

²² *ibid*, p. 42

²³ *ibid*, p. 43

²⁴ *ibid*, p. 44

group most likely to commit a crime.²⁵ Emigration was on the other hand especially high in Upper Franconia in the first part of the 1850s and the emigrants then mostly moved to Upper Bavaria. Mayr believed this emigration explained why property crime decreased considerably in Upper Franconia in the latter years, and why this was not the case for the Bavarian provinces.

Mayr further looked at Minor Violations of the Law in the seven administrative regions in the Kingdom of Bavaria. Beggary and vagrancy belonged to this category and also showed the strongest regularity out of all the subcategories. Mayr was concerned with the fluctuations in beggary and vagrancy, because he believed that these fluctuations in particular described the economic conditions. Mayr looked at male, female, and child beggary and vagrancy.

Beggary and vagrancy were most common in Upper Bavaria at the time, which Mayr claimed could be explained by the high rate of immigration. Beggary and vagrancy were on the other hand least frequent in the Franconian provinces.²⁶

Mayr stressed that it would be erroneous to interpret a higher frequency of vagrancy in a region as a signal of the population in that region being more willing to wander around, since many of the vagrants arrested in one region belonged to another administrative region. According to Mayr an increase in the immigration of poor led to an increase in the number of arrested vagrants.²⁷ He argued that this might have affected the crime rate in general, since especially beggars and vagrants were likely to become criminals later on.²⁸ It turned out that one fifth of the arrested beggars and vagrants in almost half the regions belonged to another region.

Mayr found that for the period in question women and children were more often beggars and vagrants than other kinds of violators of the law. Whereas the ratio of women per men was 20 women per 100 men for crime and offences, it was 70 women per 100 men

²⁵ *ibid*, p. 44

²⁶ *ibid*, p. 69

²⁷ *ibid*, p. 128

²⁸ *ibid*, p. 134 - 135

for beggary and vagrancy. Beggars and vagrants were often economically dependent, which was often the case for women and children, he explained, but he further wrote that it was more often the case for men than for women and children to go from being a beggar or a vagrant to becoming a criminal.²⁹ Mayr pointed out that women and especially children more often were beggars than what they are vagrants in the Kingdom of Bavaria during the period 1835/36 – 1860/61.

According to Mayr the price of the most common and necessary of all groceries, namely grain, had a decisive influence on the total fluctuations in beggary and vagrancy. Because Mayr found that the property crime moved together with the rye prices, he was not surprised by finding that the same held true for beggary and vagrancy respectively, since beggary and vagrancy both were clear indicators of poverty. Mayr stated that an economically dependent person was more likely to turn to beggary or vagrancy than to theft and hence that the grain prices probably would show a more intensive effect on beggary and vagrancy.³⁰

Mayr pointed out that he had tried to compare beggary and vagrancy with the size of the production of grain and potatoes using statistics on harvests from the year 1853. Mayr mentioned that valuable calculations performed by his colleague and at the time Director of the Bavarian Statistical Bureau, Friedrich B.W. Hermann, showed that a bad harvest in the sense of a lower amount of applicable bread fruits was in deed seen together with a high rate of beggary and vagrancy. Interestingly, the substitution of grain with potatoes made this relationship appear less strong.³¹ Mayr did unfortunately not provide the reader with data on these important findings.

²⁹ *ibid*, p. 129

³⁰ *ibid*, p. 136

³¹ *ibid*, p. 135

3.2 The article by Mehlum, Miguel, and Torvik

Mehlum, Miguel and Torvik also look at the relationship between poverty and crime in Bavaria in the period 1835/36 – 60/61, but they make a twist in the analysis, by using rainfall as an instrumental variable for the rye prices due to possible problems with endogeneity; they argue that it is in general not clear whether it is poverty that generates crime or crime that leads to poverty.³²

The Kingdom of Bavaria was a poor agrarian society in the 19th century, like many developing countries are today. Germany was much less developed than Great Britain and Belgium, and the Kingdom of Bavaria was even less developed in German terms. Rye represented an important part of the nutrition for the Bavarian population and the access to rye was therefore a measure of the living standard at that time. The authors argue that rainfall shocks have a major impact on real income in poor agrarian societies, such as the Kingdom of Bavaria in the 19th century. The authors look at rainfall as an instrument for variation in real income. In the Kingdom of Bavaria heavy rainfall typically led to bad crops.

Mehlum et al's main results are that the rye prices show a moderate, though statistically significant, *positive* effect on the property crime, and a strong statistically significant *negative* effect on the violent crime. The authors explain the latter relationship with the higher beer prices that followed the higher rye prices in Bavaria, this leading to lower alcohol consumption and less violence. They find that the OLS regression overestimates the effect that poverty had on property crime in the period. As instrumental variables they use rainfall for the current year and the two preceding years, where rainfall one year lagged has the largest effect on current rye prices.

³² Halvor Mehlum et al: "Poverty and crime in 19th century Germany", *Journal of Urban Economics* (2006), no.59, pp. 370 – 388, part. p. 371

4. A closer look

4.1 Harvests in Bavaria – important background knowledge for the analysis

In this section I look into *why* the prices were so high in 1846/47 and 1853/54. When considering the effect of poverty in these years, one should both look at what caused the poverty and what possibilities the inhabitants had to escape the situation.

In 1839 King Ludwig I appointed the German economist Friedrich Benedikt Wilhelm Hermann to the position of the Director of the newly founded Bavarian Statistical Bureau, a position he held during the rest of his life. Hermann was essentially self-educated, but was nonetheless to become a man of influence. The king thought of Hermann as a man possessed with many talents and qualities.³³ To mention some of his acknowledgments, Hermann assumed a position as a Counselor to the Ministry of the Interior in 1845, was a member of the German National Assembly in 1848-49 in Frankfurt am Main and of the Bavarian parliament from 1849 to 1855.³⁴

In 1866 Hermann published the book *Die Ernten im Königreich Bayern und in einigen andern Ländern*. Mayr was a student of Hermann and the successor to his chair at the Bavarian Statistical Bureau. Mayr mentioned in his book that there had been performed detailed investigation on the harvests in Bavaria, however only using a section of his book to comment upon these results.

It is not sufficient to look at the prices alone when investigating how poverty tended to affect the different types of crime in the Kingdom of Bavaria during the period 1835/36 – 1860/61; one must also look at the purchasing power, i.e. on how the incomes changed compared to how the prices changed. Even though we have a large data set on the price changes at the time, data on wages and income are lacking. Mayr stressed in his book that the

³³ Heinz Kurz: *op.cit.*, part. p.86

³⁴ *ibid*, part. p.87

tendencies pointed out would be the same if the food scarcity for the period was *subjective* and that the tendency would be even stronger if the subjective food scarcity appeared at the same time as the objective one. Mayr claimed (without providing the reader with data) that this really was the case *for the latter years* of the period 1835/36 – 60/61; a general increase in wages appeared at the same time as lower grain prices. This should, according to Mayr, then also explain the increase in violent crime after the year 1857.³⁵

Hermann stressed in his book from 1866 that there was nothing more important in life than the access to sufficient nutrition. Hermann complained that other and less fundamental sectors of production had been given more attention than agricultural production. As it was made clear on the first Statistical Conference *year after year a cry is made for agricultural statistics, but in vain*.³⁶ There were three main reasons, according to Hermann, why research on agricultural production was so scarce at the time.

The first reason, Hermann wrote, was that in most European countries the harvests were seldom so poor that the lack of sufficient nutrition led people to fear for their lives. He pointed out that a true *famine* in the 19th century only took place in Ireland. In Western Europe periods with high grain prices were seen in 1816/17, 1846/47 and 1854, where a true scarcity only was seen in 1816/17; in the other years of high prices the population helped itself through a lower consumption level, through the substitution of grain with potatoes and through grain trade. When the increase in grain prices was sufficiently high, the inhabitants would demand their Government to find ways to avoid further increases.³⁷ I have found data on income and expenses of the state in another statistical document by the Bavarian Statistical Bureau, showing that Bavarian state expenses were higher than state income in the years of poverty.³⁸ Hermann further wrote that the loud voices heard protesting from the streets soon would be lowered when a period of high prices was short-lived (such as in 1846/47) and the inhabitants then lost interest in attaining more knowledge about the

³⁵ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. *op.cit.*, p. 42

³⁶ Leone Levi: *op.cit.*, part. p.7

³⁷ Friedrich B.W Hermann: *Die Ernten im Königreich Bayern und in einigen andern Ländern*. XV. Heft der Beiträge zur Statistik des Königreichs Bayern. (München: 1866.), p.1

³⁸ Bayerisches Statistisches Landesamt: *op.cit.*, p.99

harvests. Even when educated men openly expressed fears, such as in the 1850s, that prices would never again return to moderate, the inhabitants saw that the prices eventually *did* go back down.

Hermann wrote that after a period with constant grain prices, the reason why the prices fluctuated was the quality of the harvest; *bad harvests led to high prices and good harvests to low prices, where less than average was produced in the former case and more than average in the latter case*. Hermann regretted the low amount of research on agricultural production, especially because such tendencies could have been made easier to see through repeated investigations.

The second reason why there had been done little research on agricultural production was according to Hermann the supposed effect of trade. Hermann wrote that one would speak highly of the freedom which trade brought with it theoretically, without considering what was actually accomplished. It was true, he wrote, that trade made consumption more independent of one's own production level; trade gave some sort of insurance, which didn't free a country from the whole damage of bad harvests, but which at least made the damages less severe. Hermann pointed out that a country's demand and supply depended on the quality of one's own harvests. Trade was seen as solidarity, being based on the mutual benefit of the trading parties. He stressed however that the countries importing grain would now experience higher grain prices (than what they would experience during their own good harvests), lowering the purchasing power of the consumers, but a true scarcity was at least avoided.

The smoothing out of consumption between trading partners was however often temporary, Hermann warned, especially for a growing population; the harvests varied from one year to the next and therefore it became difficult for one country to insure another country for a longer period. A country would always make its own inhabitants first priority. When a country with bad crops demanded grain from abroad for longer periods of time, the exporting countries would tend to increase their prices. Hermann noted that trade also was dependant on geography; a country like England would enjoy much more freedom of choice in trading partners than countries that were land-locked, he argued. Even after the railway came in place, geography could place impediments to trade. Hermann concluded that

countries on the Continent still mainly had to base their consumption on their own production.³⁹

As a third reason to why there had been performed so little research on the field Hermann mentioned the land owners' private interests, since not knowing the true value of the harvests made speculation possible. He also believed that some land owners feared higher taxation.

Hermann wrote that the value of agricultural statistics had been stressed on all the Statistical Congresses so far, without bringing any considerable changes on the topic with them. Hermann uttered that the most secure way to create agricultural statistics was to consider the books and documents with taxation registration, denoting and describing all land property.⁴⁰ The investigations became more thorough after the year 1853 and were based on estimations of average values. With increased knowledge on the acreages Hermann used the estimations from later years to look back on earlier reported yields and to reconsider the results.

Hermann provided data on how many "Schäffel" that came from one day's work in the different regions in the years 1833, 1839, 1853 and 1863. *Interestingly, Hermann found the reported yield in 1853 (which was then the harvest on which the prices for the year 1853/53 were based⁴¹) to be so low, that he didn't find these values to be credible.* If the reported yields *were* correct they would provide the lowest values out of the four years in question. Hermann wrote that by later comparisons with Belgium in 1846, he saw that such a low agricultural yield as the one reported for Bavaria in 1853 was in deed possible in other countries and that the estimates given by the Bavarian land owners might be closer to the true values than what he himself first assumed possible.

The book by Hermann has been informative as an explanation to why the Kingdom of Bavaria experienced the periods of high prices. It has however shown that research on agricultural production was scarce in this period, and one should therefore be very careful

³⁹ Friedrich B.W Hermann: *op.cit.*, p.3

⁴⁰ *ibid.*, p.3

⁴¹ Since the year 1853/54 was from October 1st 1853 – September 30th 1854

with the utilization of these data. The data at hand are mainly average values and they are also to some degree based on guesses.

4.2 Correlation and the lack thereof – prices and crime

Mayr only provided the reader with one table with the rye prices “on this side of the Rhine” and one table with the rye prices for Palatinate for the period 1835/36 – 1860/61, i.e. he did not provide tables showing the fluctuations in the rye prices within or between the seven administrative regions.⁴² Mehlum et al stress that one of the main limitations of their empirical analysis is exactly that they only have a single Bavarian rye price series for this period. Mayr did not comment on the differences in the price levels between the regions in his book. I have not found tables with the rye prices for each administrative region in any other source from the Bavarian Statistical Bureau either.

Mayr *did* however provide *graphs* for the rye prices for each administrative region, which show me how the rye prices differed between the administrative regions at the time. I have read the rye prices off these graphs, since they are so important for the analysis.

As Mehlum et al write in their article there was minimal variation in the rye prices across the regions. I have calculated the correlation in the rye prices between the different administrative regions and I find that this is true. I also note that how high the correlation coefficient between two regions is, depends on how close the different regions are situated from one another, so that e.g. the correlation coefficient is higher for the rye prices between Lower Franconia and Upper Franconia than for Lower Franconia and Upper Bavaria.

The graphs created by Mayr are to be found in the enclosures to this paper, since they were the most important material used in the analysis performed by Mayr and since they also have been so important for the analysis performed in this paper. The vertical lines divide the

⁴² The rye prices were measured in Gulden (fl) and Kreuzer (kr), where 1 Gulden = 60 Kreuzer = 240 pfennig and were measured per Bavarian “Schäffel” (1 Schäffel rye \approx 222 liters of rye). By reading the values off the graph I immediately get the right transformation of desimals, whereas Mehlum et al divided Kreuzer for each year by 60 in their data set.

period 1835/36 – 1860/61 into single years, the horizontal lines refer to the crime rate per 100 000 inhabitants, the rye prices and the number of emigrants per 100 000 inhabitants.⁴³

With respect to the article by Mehlum et al one should note that the Bavarian Statistical Bureau found it important to consider the price on "the floating bread", beer.⁴⁴ It's also worth to mention that the breweries belong to one of the oldest traditions in the Bavarian economy. The quality of the Bavarian beer is well-known. In 1820 there existed 5 000 breweries in Bavaria. There were some private breweries in addition. Later on the breweries were centralized. Concerning the production of beer unfortunately there only exist data from the 1870s.⁴⁵

Although the beer prices may very well be important to correct for in the regression analysis, one cannot claim that higher rye prices led to higher beer prices, due to the Reinheitsgebot, a food quality regulation from April 23rd 1516. In this Bavarian Purity Law it is written that the only ingredients allowed to use in beer were barley, hop, and water. (Yeast was later on included in this list of ingredients that were allowed, but in 1516 one was not yet aware of its effect on the beer.⁴⁶)

Mayr did not provide data on the barley prices in his book. I have however been able to find data on the rye, barley, and summer beer prices for each year in the period 1835 – 61 in a book published in 1933 by what is then called the Bavarian Statistical State Office.⁴⁷

After having contacted what is now called the Bavarian State Office for Statistics and Data, I became aware of the fact that the financial year in Bavaria for the period I am looking at went from October 1st to September 30th. After the German Empire was established in 1871, the financial year was set equal to the calendar year. In the statistical document from 1933 the years are referred to as 1835, 1836 and so on, whereas in both Mayr's writings as

⁴³ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. *op.cit.*, p. 38

⁴⁴ Bayerisches Statistisches Landesamt: *op.cit.*, p.29

⁴⁵ *ibid*, p.19

⁴⁶ Langenscheidt: *Großwörterbuch Deutsch als Fremdsprache*. (Berlin: 2003), p.836

⁴⁷ Bayerisches Statistisches Landesamt: *op.cit.*, p.81

well as in the publications by Hermann, the years are rather referred to as 1835/36, 1836/37 and so on.

Since the year of reference changed from when the data were registered to when these data were published in the book from 1933, it was first unclear to me what the year 1835 in the book published in 1933 refers to, i.e. one could interpret this to be an average of the calendar year January 1st – December 31st or alternatively an average for the months October 1st – September 30th. My first thought was that when a price was given for the year 1836 in the book from 1933, this meant the year denoted as 1835/36 by Mayr and Hermann, since 1836 was represented by more months by the year 1835/36 than by the year 1836/37 and since most data were provided on an annual rather than on a monthly basis, it would be hard to calculate a more accurate measure for 1836.

To check this I calculated the correlation coefficient between the rye price series for Bavaria given by Mayr for the period 1835/36 – 60/61 in his book from 1867 with the rye price series *for the period 1836 – 61* from the book published in 1933. The correlation coefficient is + 0.995, so obviously the year 1836 refers to the year 1835/36. (Since the book from 1933 converted the Gulden-prices into *Reichsmark*-prices,⁴⁸ where 100 Gulden = 171.43 Reichsmark, the tables were not compared simply by looking at them.) After noticing this, I have used the statistical source from 1933 to compute the correlation coefficients for the different variables *in the period 1836 – 61*. There is only one price series for each variable, but since the *Reinheitsgebot* not only regulated the ingredients in the beer, but also prevented fluctuations in the beer prices *between* the administrative regions, this does not pose a problem for the further analysis.

The correlation coefficient for the barley prices and the summer beer prices is + 0.69 and thereby somewhat higher than the correlation coefficient for the rye prices and the summer beer prices, which is + 0.64. That the former correlation coefficient is higher than the former is as expected, since beer was made with barley and not with rye. Interestingly, the correlation coefficient between rye and barley prices is as high as + 0.95. So even if it was the barley prices that caused the higher beer prices and not the rye prices, at a first

⁴⁸ Reichsmark was the German currency in the period 1924 – 1948.

glance it still seems possible (since the rye prices and the barley prices were so highly correlated at the time) that *the reason why the rye prices and the violent crime were negatively related to each other in the Kingdom of Bavaria during the period 1835/36 – 1860/61 is that beer was more expensive in the years of high rye prices, making people drink less in these years and therefore they were less violent.*

I then use the *exact same data file* that Mehlum et al use in their article from 2006, but I replace the Bavarian rye price series for the period 1835/36 – 60/61 (Mehlum et al work with one price series) with the Bavarian summer beer price series for the period 1836 - 61. This is done to see the direct estimated effect in the model between the beer prices and violent crime.⁴⁹ Since I have not found data on the consumption of beer for the period in question, and since there data exist only from the 1870s on the production of beer, this is the best possible test of their hypothesis which I can think of.

Mehlum et al define violent crime in the same manner as I do in my analysis, where injuries and rape are the dominant subcategories; this makes their argument all the more compelling, since such types of crime likely will occur more often when alcohol is involved. When running the regression I find that the effect of the beer prices on violent crime is also negative and statistically significant, even at the 1 % significance level (results not shown). A 1 % change in the beer prices is associated with a - 0.9 % change in violent crime (- 0.9 is the elasticity of violent crime with respect to the rye prices), so the effect is significant in every meaning of the word. I will comment further on their explanation of the negative relation between poverty and violent crime when running the fixed effects regression on my own data set (which differs in several ways from the data set which Mehlum et al use, e.g. by including rye prices for each region and also different additional variables) in Chapter 4.

I further leave their empirical twist to the analysis out of my own analysis, since I have already referred to Hermann's writings telling us that higher rye prices were seen together with a bad harvest and lower rye prices together with a good harvest. Although crime and poverty may be interlinked, given that the rye prices were fluctuating with the

⁴⁹ Excel-sheet and do file for Stata here provided by Mehlum. Rye prices are simply exchanged with alcohol prices before running the regression in the same manner as the article writers did.

harvest in this manner, I will use crime as my left hand side variable and the rye prices as a right hand side variable in my analysis.

4.3 Population size, age, and gender

Mayr corrected for population size in the sense that he looked at reported crime per 100 000 inhabitants. The data on property crime and violent crime, which I use in my analysis, are both measured accordingly. The number of *arrested* vagrants and beggars was very close to and often even equal to the number of *reported* beggars and vagrants for the period 1835/36 – 60/61. Mayr considered the number of arrests to be the better measure for vagrancy and beggary, since one person here was equal to one “crime” per arrest (which was not always the case for property crime and violent crime and therefore Mayr then used data on the number of reported crimes rather than on the number of arrested individuals). I also use data on the number of *arrested* vagrants and beggars in my analysis.

Mayr claimed it important to take both age and gender into consideration, but he did not provide the reader with complete tables for these variables for each single year and each region (perhaps because there did not exist data for every year). Mayr did however provide the reader with numerical values for every fourth year on the number of females over the age of 14 per 1000 men over the age of 14. I prefer to turn this ratio around, that is, to look at the number of men over the age of 14 per 1000 women over the age of 14, because there were more male criminals than there were female criminals. Especially when running the regression for violent crime, which then includes injuries and rape, I will expect this variable to be statistically significant and have an estimated positive sign on the coefficient. I call this variable *the adult male to female ratio*.

I have estimated the lacking values for the adult male to female ratio, by looking at whether a value has decreased or increased since the value reported four years earlier and then I have made a smooth transition from the one value to the next. It is of course unfortunate not to use the exact values for every year, but Mayr pointed out that the ratios only differed by a small amount within the regions. I use these values to correct for differences between the regions which were due to how the population was put together in terms of men per women and inhabitants over and under the age of 14.

Since I adjust for age and gender I do not look at beggary and vagrancy divided by men, women and children, like Mayr did, but rather at the total number per 100 000 inhabitants in each administrative region.

4.4 Emigration

Mayr did not provide the reader with detailed data on emigration either, rather solely with simple graphs. I have found data on emigration in another publication by the Bavarian Statistical Bureau, where we are provided with five year averages for each region in the period.⁵⁰

The five year averages do of course not give me the exact values for *any* years for the emigration variable, whereas for gender and age I at least have values for every fourth year. One way to look at how emigration fluctuated would be to use the average value for the three years in the middle of the five year period and then make a smooth transition from one average value to the next.

The graphs provided by Mayr show considerable fluctuations from year to year, which tells me that it is better to read the values off the graph for every year and every region than to make the type of estimations of the lacking values I suggested above. Since I have already taken account of age and gender in my analysis, I do not need to pay further attention to the age and gender distributions of the emigrants. This will be reflected upon through the changes in the adult male to female ratio of the population.

Mayr found it important to look at where the vagrants came from, but he did not enclose tables on such data. The tables I am using are based on *where* the vagrants were arrested. It would be interesting to use data on immigration as a right hand side variable when I consider vagrancy as the dependent variable in order to say something about how strong the tendency for immigration to affect vagrancy was in the Kingdom of Bavaria

⁵⁰ Das Königliche Statistische Bureau: *Die Bewegung der Bevölkerung im Königreiche Bayern in den fünf Jahren 1857 / 58 bis 1861 / 61 mit Rückblicken auf die 22 Jahre 1835 / 36 bis 1856 / 57*. (München: 1863), p. 74

during the period 1835/36 – 1860/61. Unfortunately I have not found detailed data on immigration.⁵¹

4.5 Mortality and fertility

The Bavarian Statistical Bureau published data on the mortality for both girls and boys in the different administrative regions for every year in the whole period 1835/36 – 60/61. One problem with measuring poverty by mortality is that according to the Bavarian Statistical Bureau children born by single mothers might not always have been registered in the beginning of the 19th century. This gradually changed, as one saw that children born outside of marriage could lead to their parents being married later on. This might imply that what looks like an increase in mortality over time rather might indicate an increase in the number of registrations. However, given that mortality was as large within the group of children born outside marriage as it was within marriage, the change in registration should not affect the fluctuations in mortality.

I have found five year averages for the number of stillborn among illegitimate children and legitimate children for each administrative region over the period. The numbers show that for all seven administrative regions the percentage of stillborn was in deed higher within the group of illegitimate children. This was true for all five year averages over the period. One might further, with regard to possible measurement errors, question which illegitimate children were not registered. These were likely to be exactly those stillborn or who died early, since they were easier to keep away from registering. In that case the difference in mortality in the age 0 – 1 year between the two groups could be even higher.

The first census from 1834 shows a population numbering 4 246 778, whereas the population had increased to 4 689 837 in 1861, which implies a total increase of 443 059 or 10.4 %. The increase in the population was however stronger in the first part of the period. The smallest increase was seen in the period 1846 – 1849. In the period 1852 – 1855 there was even a decrease in the population.⁵² Note that these two periods in fact include the years

⁵¹ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. *op.cit.*, p. 125

⁵² Das Königliche Statistische Bureau: *op.cit.*, p.88

of poverty which Mayr pointed out. When including the variable for the number of children born, the age and gender distribution in the population has already been corrected for. It is however unfortunate that data are lacking on the number of marriages in the period, due to the prevailing social norms and religious doctrines. When considering mortality and fertility in the Kingdom of Bavaria during the period 1835/36 – 1860/61, it is important knowledge that solicitation, bigamy and abortion all were listed under the category Crime and Offences against the Private Person.⁵³

I have not found data on the number of stillborn for each year. This implies that I do not have data on infant mortality, since infant mortality should exclude the number of stillborn from the number of deaths in the age group 0 – 1 year, whereas my values include the number of stillborn. I therefore choose not to call this variable infant mortality, but rather *mortality in the age group 0-1 year*.

4.6 Variables not controlled for

Among the topics discussed on the first Statistical Conference were population, territory, emigration, agricultural statistics, commercial statistics, economical budgets (with particular interest paid to the working classes and the means of subsistence of the masses), statistics of indigence or pauperism (causes, effects, and charitable institutions), educational statistics (including special provisions for the poor), and criminal statistics.⁵⁴ Since the Conference was held towards the end of the period in question, this might explain that data are lacking on some of these variables, many of which I otherwise would include in my analysis. Variables on agricultural statistics would have been of particular interest, data on which I have shown is lacking by referring to the writings of Hermann.

Even though Mayr stated that marriage had a clear effect on crime (both property crime and the number of female beggars/vagrants), he did not provide the reader with detailed data here. I have found five year averages from the Bavarian Statistical Bureau on

⁵³ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. *op.cit.*, p.7

⁵⁴ Leone Levi: *op.cit.*, part. pp. 1- 3

marriages, divorces and religion. Variation is seen both within and between the different administrative regions for the period 1835/36 – 1860/61. It implies guessing on how these variables moved from year to year and I will therefore not be able to control for them in my analysis.

5. Putting it all together – panel data analysis

5.1 About panel data analysis

The definition of panel data is data that consist of observations on the same n entities at two or more time periods T .⁵⁵ In my data set I have seven entities (the seven administrative regions) and twenty six time periods (1835/36 – 60/61), so I am looking at a total of $7 \times 26 = 182$ observations. I use the subscript i when referring to the entity and t when referring to the time period of the observation. Y_{it} thereby describes the variable Y observed for the entity i in time t .

I have a *long, narrow panel*, meaning that I have a lot of time series observations on each of a small number of cross-sectional units. If it hadn't been for missing values for property crime and violent crime for three of the administrative regions in the year 1858, the panel would also be *balanced*, i.e. the panel would have all its observations (the variables are then observed for each region and each year).⁵⁶

I make *two main regressions*, one with violent crime and one with property crime as the dependent variable. I make two supplementary regressions, one with beggary and one with vagrancy as the dependent variable. The panel data set further contains variables on the rye prices, mortality in the age group 0 – 1 year, the number of children born, emigration, and the adult male to female ratio.

In order to perform the regressions, I cannot have perfect multicollinearity. Perfect multicollinearity, which is a feature of the entire set of regressors, arises when one of the regressors is a perfect linear combination of the other regressors.⁵⁷ I can therefore not include all the region dummies from my panel data plus a common intercept, because if I do the

⁵⁵ J.H. Stock and M.W Watson: *Introduction to Econometrics*. (Pearson International Edition: 2007), p.350

⁵⁶ Peter Kennedy: *A guide to Econometrics*. (Blackwell Publishing: 2003)

⁵⁷ J.H. Stock and M.W Watson: *op.cit.*, p.350

regressors would be perfectly multicollinear (the “dummy variable trap”). I therefore omit the binary variable for the first administrative region, which in my case is Lower Franconia.⁵⁸

I let $R2_i$ (R = region) be a binary variable that equals 1 when $i = 2$ and equals 0 otherwise; I let $R3_i$ equal 1 when $i = 3$ and 0 otherwise; and so on. In my analysis I then use Lower Franconia as the reference region (region 1). The coefficients on the included binary variables should then be interpreted as *the incremental effect of being in that category, relative to the base case of the omitted category, holding constant the other regressors*.⁵⁹ The coefficient on e.g. Upper Franconia is the average difference in the effect on the dependent variable between Upper Franconia and Lower Franconia, holding constant the other variables in the regression. Upper Franconia = region 2, Middle Franconia = region 3, Upper Palatinate = region 4, Swabia = region 5, Upper Bavaria = region 6, Upper Bavaria = region 7.

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \dots + \beta_k X_{k,it} + \alpha_2 R2_i + \alpha_3 R3_i + \dots + \alpha_7 R7_i + u_{it}$$

Here $\beta_0, \beta_1 \dots \beta_k, \alpha_2, \alpha_3 \dots \alpha_7$ are unknown coefficients to be estimated.

If I included all the period dummies in addition, we would lose so many degrees of freedom that the period dummies would possibly “eat up” the effect of the other explanatory variables. I have instead included year dummies for the more important years, commented on in section [4.2]. In addition, I have included a trend variable in each of my three regressions. I expect the fluctuations for the rye prices, beggary and vagrancy to be larger *within* the administrative regions than *between* them and I should therefore use the within estimator (the fixed effects estimator). By plotting the dependent variable against the different explanatory variables separately, I also find a linear specification to be the most appropriate.

For all four equations I correct for heteroskedasticity and cluster by years, also corrected for in the regression analysis performed in the article written by Mehlum et al.

⁵⁸ Alternatively I could have included binary variables for all the n entities, but then excluded the constant term β_0 , but I follow the former procedure by convention.

⁵⁹ J.H. Stock and M.W. Watson: *op.cit.*, p. 208

Whether the errors are homoskedastic or heteroskedastic, the OLS estimator is unbiased, consistent, and asymptotically normal. If the errors are heteroskedastic however, then the homoskedasticity-only standard errors are not valid because they were derived under the false assumptions of homoskedasticity.⁶⁰

Clustering by years corrects for the possibilities that the error terms are correlated between the regions within the same year. The main reason for expecting this is that the omitted variables may work in the same direction in all the seven regions. The fluctuations in the rye prices appear to be random (according to Hermann the quality of the harvest was determining the rye prices) and the rye prices again affect all the other explanatory variables and most likely also the omitted variables I have not been able to correct for. The fluctuations in the rye prices appear to be very similar across the regions and how high the correlation coefficient between the rye prices in two regions is depends on how close the different regions are situated from one another. Since the fluctuations in the omitted variables show themselves in fluctuations in the error terms and given that these fluctuations are driven by fluctuations in the rye prices, I should therefore cluster by years.

I tried to run the regressions without clustering as well. The estimated coefficients then remain the same, but I see that the effect of the rye prices on the respective dependent variables is overestimated when I do not cluster by years, since its estimated standard error has now decreased.

⁶⁰ J.H. Stock and M.W Watson: *op.cit.*, p. 163

Table 1: Summary statistics

Variable		Mean	Std. Dev.	Coeff. of variation
Property crime	overall	291	79	0.27
	between		63	0.22
	within		53	0.18
Violent crime	overall	54	23	0.43
	between		12	0.22
	within		20	0.37
Adult m/f ratio	overall	944	40	0.04
	between		40	0.04
	within		15	0.02
Emigration	overall	147	143	0.97
	between		103	0.7
	within		107	0.73
Rye prices	overall	13	4.8	0.37
	between		0.6	0.05
	within		4.7	0.36
Mortality 0 -1 year	overall	3361	660	0.196
	between		673	0.2
	within		213	0.06
Children born	overall	19126	2762	0.14
	between		2733	0.14
	within		1090	0.06
Beggary	overall	745	292	0.39
	between		147	0.197
	within		257	0.34
Vagrancy	overall	989	433	0.44
	between		277	0.28
	within		349	0.35

5.2 Different specifications

5.2.1 Property crime as the dependent variable

In Table 2 I consider property crime as the dependent variable, i.e. the variable to be explained in the regression or the *endogenous* variable. My right hand side variables in [OLS 1] are emigration, the adult male to female ratio, beggary, vagrancy, mortality in the age group 0 – 1 year, the number of children born, the years of poverty (i.e. 1846/47 and 1853/54), and a trend variable. In [OLS 2] I consider the same right hand side variables and in addition I include a variable for the rye prices. I do not include violent crime as a right hand side variable in either equation, because this might lead to an endogeneity problem.

5.2.2 Violent crime as the dependent variable

In Table 3 I look at violent crime as the dependent variable. My right hand side variables in [OLS 1] are emigration, the adult male to female ratio, beggary, vagrancy, the years of poverty, and a trend variable. I also include the latter three years in the period (i.e. 1858/59, 1859/60, 1860/61), since Mayr pointed out in his book that violent crime increased considerably in these years. In [OLS 2] I add the variable for rye prices to the regression and in [OLS 3] I include the variables on mortality in the age group 0 – 1 year and the number of children born.

5.2.3 Beggary as the dependent variable

In Table 4 I set beggary to be my dependent variable. My right hand side variables in [OLS 1] are emigration, the adult male to female ratio, mortality in the age group 0 – 1 year, the number of children born, the years of poverty and a trend variable. In [OLS 2] I include the variable for rye prices. Due to a possible endogeneity problem I do not include the variable for vagrancy.

5.2.4 Vagrancy as the dependent variable

In **Table 5** I consider vagrancy as the variable to be explained in the regression. My right hand side variables in [OLS 1] are emigration, the adult male to female ratio, mortality in the age group 0 – 1 year, the number of children born, the years of poverty and a trend variable. In [OLS 2] I include the variable for rye prices.

Table 2**Property crime as dependent variable**

	[OLS 1]	[OLS 2]
Rye prices		5.4 (1.54)***
Emigration	0.07 (0.06)	0.03 (0.06)
Vagrancy	0.04 (0.02)**	0.03 (0.015)*
Beggary	0.02 (0.02)	- 0.02 (0.02)
Adult male to female ratio	0.21 (0.33)	0.2 (0.25)
Children born	0.001 (0.006)	0.002 (0.006)
Mortality, age 0-1 year	0.004 (0.02)	0.005 (0.02)
Year 1846/47	69.3 (9.71)***	35.98 (14.54)**
Year 1853/54	32.6 (19.08)*	8.7 (19.9)
Trend	1.5 (0.75)*	- 0.3 (0.91)
Constant term	- 45.6 (335.78)	- 94.6 (285.76)
R2	0.72	0.76
Root MSE	43.6	40.8
Observations	179	179
Mean of dependent variable	290.6	290.6

Notes. Fixed effects regression. Robust standard errors in parentheses. Cluster by years.

* Significantly different than zero at 90 % confidence.

** Idem, 95 %

*** Idem, 99 %

Table 3

Violent crime as dependent variable

	[OLS 1]	[OLS 2]	[OLS 3]
Rye prices		- 0.83 (0.27)***	- 0.75 (0.27)***
Emigration	- 0.006 (0.01)	- 0.0007 (0.01)	0.006 (0.01)
Vagrancy	0.006 (0.004)*	0.008 (0.004)*	0.006 (0.004)
Beggary	- 0.02 (0.005)***	- 0.02 (0.005)***	- 0.009 (0.004)**
Adult male to female ratio	0.008 (0.07)	0.006 (0.07)	- 0.03 (0.07)
Children born			0.005 (0.001)***
Mortality, age 0-1 year			0.003 (0.005)
Year 1846/47	- 5.26 (2.02)**	- 0.07 (2.22)	- 0.18 (3.31)
Year 1853/54	- 7.01 (4.31)	- 3.37 (3.75)	- 6.4 (5.09)
Year 1858/59	30.0 (3.44)***	28.1 (3.24)***	25.9 (3.5)***
Year 1859/60	34.7 (3.34)***	35.3 (3.07)***	34.8 (2.96)***
Year 1860/61	34.4 (3.61)***	35.6 (3.32)***	34.8 (3.3)***
Trend	0.49 (0.16)***	0.75 (0.17)***	0.5 (0.2)**
Constant term	58.7 (62.3)	63.9 (64.5)	4.2 (65.1)
R2	0.75	0.76	0.79
Root MSE	11.9	11.7	11.0
Observations	179	179	179
Mean of dependent variable	54.4	54.4	54.4

Notes. Fixed effects regression. Robust standard errors in parentheses. Cluster by years.

* Significantly different than zero at 90 % confidence.

** Idem, 95 %

*** Idem, 99 %

Table 4**Beggary as the dependent variable**

	[OLS 1]	[OLS 2]
Rye prices		31.9 (5.39)***
Emigration	0.3 (0.22)	0.02 (0.19)
Adult male to female ratio	1.31 (1.18)	0.9 (1.02)
Children born	- 0.09 (0.03)***	- 0.06 (0.02)***
Mortality, age 0-1 year	- 0.13 (0.13)	- 0.1 (0.10)
Year 1846/47	176.4 (42.0)***	- 62.5 (61.05)
Year 1853/54	263.7 (60.86)***	59.6 (69.22)
Trend	- 2.7 (4.72)	- 12.6 (3.32)***
Constant term	1215.6 (1104.22)	787.1 (955.67)
R2	0.46	0.58
Root MSE	222.25	196.64
Observations	182	182
Mean of dependent variable	745	745

Notes. Fixed effects regression. Robust standard errors in parentheses. Cluster by years.

* Significantly different than zero at 90 % confidence.

** Idem, 95 %

*** Idem, 99 %

Table 5

Vagrancy as the dependent variable

	[OLS 1]	[OLS 2]
Rye prices		39.1 (12.4)***
Emigration	0.67 (0.39)*	0.3 (0.36)
Adult male to female ratio	3.89 (1.49)**	3.4 (1.68)*
Children born	- 0.07 (0.06)	- 0.03 (0.04)
Mortality, age 0-1 year	- 0.18 (0.20)	- 0.14 (0.18)
Year 1846/47	195.6 (73.1)**	- 96.7 (128.4)
Year 1853/54	323.6 (100.7)***	73.8 (137.7)
Trend	4.33 (8.89)	- 7.7 (7.2)
Constant term	- 1686.9 (1704.44)	- 2211.3 (1706.6)
R2	0.5	0.58
Root MSE	318.9	292.96
Observations	182	182
Mean of dependent variable	989	989

Notes. Fixed effects regression. Robust standard errors in parentheses. Cluster by years.

* Significantly different than zero at 90 % confidence.

** Idem, 95 %

*** Idem, 99 %

5.3 Interpretation

An underlying problem in the regression analysis of this section is that the causality may run both ways, i.e. I may have an endogeneity problem in several of the regression equations. A variable is endogenous when it is correlated with the error term. If a right hand side variable is endogenous, it implies that its estimated coefficient in the OLS regression is biased. I should then use an instrumental variable regression instead of OLS. As I argue in Chapter 4, in his book from 1866 Hermann wrote that higher rye prices were seen together with a bad harvest and lower rye prices together with a good harvest. Although crime and poverty may be interlinked, given that the rye prices were fluctuating with the harvest in this manner, I can use crime as my left hand side variable and rye prices as a right hand side variable in my analysis.

There are however other possible endogeneity problems in my regressions. I will comment further on these when running the different regressions, but I note at once that the problem then is that I do not find an instrument that is relevant and exogenous out of the variables already included in my data set and this data set contains all the variables on which I have found detailed data (detailed in the sense *each year, each region*).

Table 2 and Table 3 present the answers to my main question in this paper, namely whether or not I find support for Mayr's asserted strong link between poverty and property crime on the one hand and poverty and violent crime on the other when using a modern software tool, where I correct for more variables, correct for heteroskedasticity, and cluster by years. By looking at the summary statistics I see that the largest variation for the most important explanatory variables (with respect to Mayr's arguments), namely for the rye prices, beggary, and vagrancy, takes place *within* the regions, rather than *between* the regions, so I was right in my assumption that a fixed effect regression is most appropriate (the fixed effect estimator is also called the within estimator). The mean of the rye prices is 13, with a standard deviation for the rye prices at only 0.6 *between* the regions, whereas this variation is 4.6 *within* the administrative regions. Table 4 and Table 5 are supplementary tables.

The standard deviation of the random variable Y has the units of Y . It measures the spread of the distribution of this variable around its mean.⁶¹ I have included *the coefficient of variation* because it indicates something about the severity of the ups and downs for the variable in question. It is calculated by dividing the standard deviation by the mean of the variable, i.e. it is simply the ratio between the two. Considering the most important variables for the analysis, we see that for our fixed effect regression, the coefficient of variation is 0.36 for the rye prices, 0.34 for beggary and 0.35 for vagrancy, so there are quite strong fluctuations in the data set.

A variable is *statistically significant* when the null hypothesis that the regression coefficient is zero is rejected at a given *significance level*. Saying that a variable is statistically significant at the 5 % significance level means that we follow a procedure such that a correct null is rejected in five out of a hundred cases, i.e. it is a 5 % chance of a Type I error (the size of the test is then 5 % and the power of the test is 95 %). Alternatively, we might say that we reject the null with 95 % confidence (the 95 % confidence interval, i.e. the interval that contains the true value of the coefficient with 95 % probability, will not include the value zero).⁶²

What lies closer to the dependent variable in the correlation chain affects it the most, which should be mentioned before going through the different specifications. When a variable goes from being statistically significant at the 1 % significance level to not being statistically significant even at the 10 % level after including another variable, and seeing this newly included variable statistically significant, it may imply that the former variable was a proxy for the latter and that the latter lies closer up to the dependent variable in its explanatory power.

Woytinsky stresses in an article from 1929 the weight of evidence that Mayr has given us for the connection between the rye prices and property crime, even though technically the diagrams that Mayr presented us to are unsatisfactory.⁶³ Mayr found that it

⁶¹ J.H. Stock and M.W. Watson: *op.cit.*, p. 781

⁶² *ibid*, p.79

⁶³ Wladimir S. Woytinski: *op.cit.*, part. p. 648

was generally so that the rate of simple theft decreased when the rye prices decreased, which is supported by the results from the first regression equation in Table 2. The year 1846/47 has the expected positive sign on the estimated coefficient and I can reject the null at any normal level (the p-value is close to zero). The other year of poverty I am considering, i.e. 1853/54, also enters the regression equation with a positive sign on the coefficient, but only at the 10 % significance level.

Mayr argued that especially beggars and vagrants were likely to become criminals later on. It is therefore interesting to see how the number of beggars and vagrants arrested one year tended to affect the number of other crimes reported that same year. Vagrancy in deed enters the regression with an estimated positive coefficient, statistically significant at the 5 % level. This is another indication of the rise in property crime in poor times. The variable for beggary has an estimated positive coefficient, but is not statistically significant. The trend variable has an estimated positive coefficient and is statistically significant at the 10 % level. Note that this variable is no longer statistically significant when I move from [OLS 1] to [OLS 2] in Table 2, i.e. when I include the rye prices in the regression equation.

When including the variable for the rye prices, the latter year of poverty is no longer statistically significant, so it appears to be the high rye prices in this year that made it statistically significant before. The year 1846/47 is however still statistically significant at the 5 % level, which might imply that poverty was so severe in this year, that correcting for the rye prices does not correct for its positive effect on property crime. The variable for the rye prices has an estimated positive sign on the coefficient and the p-value is 0.002, i.e. the smallest significance level at which I can reject the null hypothesis is 0.2 %. *Mayr argued that theft was more common when it became more difficult to obtain food legally and that one naturally could conclude that property crime would increase with food scarcity.* This is supported from the empirical results in Table 2. I have calculated that the elasticity of property crime with respect to the rye prices is 0.24, so that an increase in rye prices of 1 % leads to an increase in property crime of approximately 0.24 %.⁶⁴ Further, when the rye

⁶⁴ Estimated coefficient of the rye prices multiplied with the average rye price divided by the average property crime.

prices increase with a one standard deviation, there is an increase in property crime by an approximate 0.48 standard deviation.⁶⁵

Vagrancy is now statistically significant at the 10 % level. Mayr wrote that food scarcity would lead some people to emigrate and criminality would decrease when people in distress wandered out. It has therefore been important to include the variable emigration in my analysis. From Table 2 I however see that this variable does not enter either of the OLS equations with statistical significance.

Although Mayr found it important to consider the age and gender distribution, the variable for the adult male to female ratio does not enter either equation with statistical significance. Neither the variable for the number of children born nor the variable for mortality in the age group 0 – 1 year enters any of the two regression equations in Table 2 with statistical significance, so I will not evolve further on this. Notice that R^2 in the second OLS regression in Table 2 is 0.76, an indication that quite a large fraction of the sample variance of the dependent variable is explained by the regressors.⁶⁶

Mayr argued that the different types of crime had different motives; he wrote that whereas simple theft was driven by distress, the violent crime was a result of crudity and passion. Mayr did not evolve further on why these differences in motives would lead poverty to have a negative effect on violent crime, but nonetheless pointed out that this was the relationship he expected to find and in order to show this he made graphical illustrations of how violent crime fluctuated in proportion to the rye prices as well. I assume that what he meant to say was that when poverty was most severe, people were more occupied with putting food on the table than with going out fighting and raping – or, according to Mehlum et al, more occupied with providing food than going out to *drink* and then to fight and rape.

By looking at [OLS 1] in Table 3 I find that the year 1846/47 has a negative estimated coefficient and is statistically significant at the 5 % level. Mayr pointed out that violent crime

⁶⁵ Estimated coefficient of the rye prices multiplied with the standard deviation of the rye prices divided by the standard deviation of property crime.

⁶⁶ J.H. Stock and M.W Watson: *op.cit.*, p.781

was at its lowest in this year. The year 1853/54 also has a negative estimated coefficient, but this dummy variable is not statistically significant even at the 10 % significance level.

In the latter three years of the period violent crime increased considerably. Mayr alleged that violent crime increased in these years because there was easier access to food, both objectively and subjectively; the grain prices were moderate and the wages increased considerably all over.⁶⁷ Theft however also became more common in these years, which Mayr thought could *not* be seen together with the grain prices (since those were relatively low in the latter years of the period). He declared that the change was probably rather due to a change in how the population was put together. Since I do not have detailed data on immigration, and since I lack information on where the emigrants moved to from year to year, I have decided not to include these three years in the other tables. I believe the results would be difficult to interpret and I have checked that the main results from these regressions do not change whether or not I add these latter three years.

Each of the latter three years in deed enters the first regression equation in Table 3 with a positive sign on the estimated coefficient. For all three years I can reject the null at any normal level.

Beggary enters the first OLS equation in Table 3 with an estimated negative coefficient and I can reject the null at any normal level, which then is another indication that there is a negative relationship between poverty and violent crime. The estimated coefficient for the variable vagrancy is however positive and the variable is statistically significant at the 10 % level. Vagrancy should be an indicator of poverty as well, so this result is puzzling. It might be an indicator that violent crime often was committed by vagrants, but I will make no strong assertions here. The variable for the adult male to female ratio is not statistically significant, which I also find a bit surprising, considering what types of crime we are looking at here (mainly injuries and rape). The trend variable is estimated to have a positive coefficient and the variable is statistically significant even at the 1 % level.

From the second OLS regression in Table 3, where I include the variable for the rye prices, I find this variable to have the expected negative sign on the coefficient. The lowest

⁶⁷ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern. op.cit.*, p. 44

significance level at which I can reject the null is 0.6 %. I have calculated that the elasticity of violent crime with respect to the rye prices is - 0.20, so that an increase in rye prices of 1 % leads to an increase in violent crime of approximately 0.20 %. Further, when the rye prices increase with a one standard deviation, there is an increase in violent crime by an approximate 0.2 standard deviation.

None of the poverty years enter the equation with statistical significance anymore, so it was obviously the high rye prices in these years that made them statistically significant in the first regression equation. For the latter three years I can reject the null at any normal level and each of the years have a positive sign on the estimated coefficient. There might very well have been other important explanatory factors than better days leading to the rise in violent crime in these latter years. For the trend I can now reject the null at any normal level and this variable has a positive sign on the estimated coefficient. Beggary is still estimated to affect violent crime negatively and the variable is statistically significant even at the 1 % level after including the rye prices. Vagrancy also still has a negative sign on the estimated coefficient and is statistically significant at the 10 % level.

I will stress two possible explanations (of course there could be many more) of why there was a tendency for poverty to affect violent crime negatively in the Kingdom of Bavaria in the period 1835/36 – 60/61. The first possible explanation is that in poor times the Bavarians were too exhausted by and too preoccupied with covering their most basic needs such as food and shelter to commit any violent crime. This is also how I believe Mayr, interpreting his somewhat unclear explanation, saw the link between poverty and violent crime. The second explanation is the one which Mehlum et al present in their article. I note that since I can reject the null for the rye prices even at the 0.6 % significance level (and since the rye prices were so highly correlated with the barley prices, and since barley was an important ingredient in the beer), I do not reject their way of reasoning, but I leave it out of the rest of my analysis.

Moving over to the third OLS regression in Table 3 I include variables for the number of children born and for the mortality in the age group 0 – 1 year and R^2 then increases from 0.76 to 0.79. The number of children born has a positive sign on the estimated coefficient and the variable is statistically significant even at the 1 % level. One might interpret this by claiming that the number of children born works as a proxy for welfare, since when poverty

decreases, optimism increases and the number of children born might be a sign of this optimism. This then supports Mayr's finding that there was a positive link between welfare and violent crime.

The argument that more children were born when there was more welfare can be supported by another statistical document from the Bavarian Statistical Bureau, where it was shown that fertility was higher in wealthier years in the Kingdom of Bavaria during the period 1835/36 – 60/61; the data from the Bavarian Statistical Bureau show, and this is also explicitly pointed out in the text of this document, that the number of births declined in the years with higher wheat prices or more precisely in the year *following* a year of poverty.⁶⁸ The minimum number of births was seen in 1854/55 and the second lowest number in 1847/48, both years following the two years of poverty I have been looking at. This can then be interpreted as optimism itself leading to population growth, which way of reasoning may be traced back to the writings of Adam Smith, who argued that a man's wage must be sufficient to support two children, as well as the wage earner himself.⁶⁹ These results may however also be explained by higher (lower) prices leading to poorer (better) health due to the insufficient (sufficient) access to food and therefore a lower (higher) fertility.

Since rape was one of the two main crime subcategories belonging to violent crime, we might however have an endogeneity problem when including the number of children born in the third OLS regression in Table 4 (meaning that the number of children born was affected by violent crime). Because of the possible endogeneity bias, *I disregard the third OLS regression and find the second OLS regression in Table 3 the best one to use in my analysis of violent crime*. Notice that R^2 in the second OLS regression in Table 3 is 0.76, an indication that quite a large fraction of the sample variance of the dependent variable is explained by the regressors.

Mayr wrote that the rye prices had a decisive influence on the total fluctuation in beggary and vagrancy and argued.⁷⁰ From Table 4, where I consider beggary as the

⁶⁸ Das Königliche Statistische Bureau: *op.cit.*, p. 95

⁶⁹ Nancy Folbre: "The Improper Arts: Sex in Classical Political Economy", Population and Development Review 18 (1992), No.1, pp. 105 – 121, part. p. 110

⁷⁰ Georg Mayr: *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. *op.cit.*, p. 136

dependent variable, I see from the first OLS regression that each year of high prices has the expected positive sign on the estimated coefficient and I can reject the null at any normal level. The variable for the number of children born has a negative sign on the estimated coefficient and is statistically significant even at the 1 % level. One might either interpret this as a lower fertility among beggars *or* as the number of children born being a proxy for welfare. That the adult male to female ratio does not enter with statistical significance should not come as a surprise to the reader, since Mayr pointed out that the participation in beggary was high among women and children.

When including the variable for the rye prices in Table 4 I see that R^2 jumps from a low 0.46 to 0.58, so this variable seems to add a lot of explanatory power to the equation. The variable for the rye prices has the expected positive sign on the estimated coefficient and I can reject the null at any normal level. I have calculated that the elasticity of beggary with respect to the rye prices is 0.56, so that an increase in the rye prices of 1 % leads to an increase in beggary of approximately 0.56 %. Further, when the rye prices increase with a one standard deviation, there is an increase in beggary by an approximate 0.58 standard deviation. The variable for the number of children born still has a positive sign on the estimated coefficient and the smallest significance level at which I can reject the null is 0.2 %. The trend is statistically significant at the 1 % level and this variable has an estimated negative sign on the coefficient.

In Table 5 I consider vagrancy as the dependent variable. I here also I find that each year of poverty enters the regression with the expected estimated positive sign on the coefficient, the year 1846/47 being statistically significant at the 5 % level and the year 1853/54 even at the 1 % level. The adult male to female ratio is statistically significant at the 5 % level, with a positive sign on the estimated coefficient. This might be explained by referring to Mayr's comment on women and children being less able to move around at the time than what men were. The variable for emigration has a positive sign on the estimated coefficient and is statistically significant at the 10 % level. This might reflect that some of the vagrants arrested belonged to the region they were arrested in (they wandered around within the region rather than crossing the border).

When I include the variable for the rye prices in the second OLS regression in Table 5 I find that it has the expected positive sign on the estimated coefficient and I can reject the

null even at the 0.4 % significance level. R^2 makes a jump upwards from 0.50 to 0.58. I have calculated that the elasticity of vagrancy with respect to the rye prices is 0.51, so that an increase in the rye prices of 1 % leads to an increase in vagrancy of approximately 0.51 %. Further, when the rye prices increase with a one standard deviation, there is an increase in vagrancy of an approximate 0.53 standard deviation. None of the years of poverty are now statistically significant, so their statistical significance before was most likely driven by the high rye prices in these years.

After including the rye prices, I see that the adult male to female ratio still is statistically significant at the 10 % level. Comparing the tendencies seen in Table 4 with those in Table 5 thereby gives support for Mayr's finding that women and especially children were more often beggars than what they were vagrants.

Mayr pointed out that a higher frequency of vagrancy in a region should not be interpreted as a signal of the population in that region being more willing to wander around, since many of the vagrants arrested in one region belonged to another administrative region. Since we are looking at where the vagrants were reported rather than where they originally came from, this may explain why the variable for emigration now does not enter the regression equation with statistical significance. According to Mayr, vagrancy would rather show itself in the data through increased immigration, on which we unfortunately do not have detailed data and which therefore is not included in my panel data set. That the variable for emigration is statistically significant when I exclude the rye prices may be interpreted as emigration being more common in years of poverty (as Mayr argued) and therefore emigration might work as a proxy for the rye prices in the first OLS regression in Table 5.

Mayr assumed that the rye prices would show an even more intensive effect on beggary and vagrancy than on property crime. By looking at the elasticities, this argument is supported by my own empirical findings. I might have an endogeneity problem in both the regression for vagrancy and in the regression for beggary, though, due to the poorer health of beggars and vagrants, which might affect both fertility and mortality. Then I must exclude these variables, and since we already seem to have a severe omitted variable bias, not much explanatory power is left.

One has to be aware of the danger of the so-called “ecological fallacy” when interpreting the data; *a logical fallacy inherent in making causal inference from group data to individual behaviors*,⁷¹ which is exactly what I find to be the main problem with Mayr’s way of reasoning, although he certainly *did* point out that the statistician could only look into possible causal chains as long as these could be supported scientifically by connecting data on crime with data on factors that influenced crime. With simple graphs and tables he should however not be able to say much about how strong these tendencies were and to what degree his assumptions were supported by the data at hand.

Mayr can obviously not be blamed for the lack of access to more sophisticated analytical tools. It has however been one of the more important tasks of this paper to compare how a 19th century statisticians concluded with how one would reason today. Many authors, like Mayr himself, sometimes tend to mistakenly infer individual-level relationships from relationships observed on the aggregate level. Mayr at times wrote of the morality in the population simply after referring to five year averages or even merely snapshots of the economy.

We should rather speak of tendencies on the aggregate level and then say what we find to be a possible relationship on the individual level, which is exactly what I have done in this section. There are *tendencies* in the data, showing that in poor years, there was on the one hand less violent crime and on the other hand more property crime and more beggary/vagrancy in the Kingdom of Bavaria during the period 1835/36 – 1860/61.

⁷¹ Sally Macintyre and Anne Ellaway. “Ecological Approaches: Rediscovering the Role of the Physical and Social Environment”, in *Social Epidemiology* (New York: Oxford University Press, 2000), edited by Lisa F. Berkman and Ichiro Kawachi, pp. 332 -348, part. p. 332.

6. Conclusion

Mayr was one of the first statisticians to show how the grain prices tended to move together with property crime.⁷² This is in my view also his most important empirical finding.

Although Mayr was a 19th century statistician, who did not have access to the modern software tools we have today, his findings, illustrated by simple tables and graphs, are to a large degree supported by the tendencies seen when using more sophisticated econometrics. His main empirical findings were that higher rye prices tended to lead to more property crime, but less violent crime. Having created a panel data set where I also include more variables and by running regressions correcting for heteroskedasticity and clustering by years, I find that the variable for the rye prices has a moderate, statistically significant *positive* effect on property crime and a moderate statistically significant *negative* effect on violent crime, both times even at the 1 % level.

The tendency for poverty to affect property crime positively may be explained by theft increasing in years of high prices so that one still could put food on the table. The tendency for poverty to affect violent crime negatively may be explained by (i) the Bavarians being too exhausted by and too preoccupied with putting food on the table in years of poverty that they committed less violent crime or by (ii) the Bavarians now not affording to drink as much and this decreased alcohol consumption may have led to less violent crime.

One cannot claim that higher rye prices led to higher beer prices for the period in question, due to the Reinheitsgebot, a food quality regulation from April 23rd 1516. This Bavarian Purity Law said that the only ingredients allowed to use in beer were barley, hop, and water. Even if it was the barley prices that caused the higher beer prices and not the rye prices, at a first glance it still seems possible, since the rye prices and the barley prices were so highly correlated, that *the reason why the rye prices and the violent crime were negatively related to each other was that beer was now more expensive and people therefore drank less and then were less violent*. After having exchanged the rye prices with the beer prices in the data set which Mehlum et al use I find that the variable for the beer prices is statistically significant in the regression for violent crime, even at the 1 % level. A 1 % change in the

⁷² William Adrian Bongers: "Criminality and Economic Conditions", *The Modern Criminal Science Series*. (London: 1916), part. p. 568

beer prices is associated with a - 0.9 % change in violent crime, so this effect is significant in every meaning of the word.

Mayr also looked closer into how poverty affected beggary and vagrancy and he assumed that the rye prices would show an even more intensive effect on these variables. This is supported by my own empirical findings. I find that the rye prices have a strong positive effect on both these variables, statistically significant even at the 1 % level. By looking at the elasticities I find that an increase in the rye prices of 1 % leads to an increase in beggary of approximately 0.56 % and to an increase in vagrancy of approximately 0.51 %. When using either beggary or vagrancy as the dependent variable, I might however run into endogeneity problems in a regression already having a severe omitted variable bias, so that the exclusion of further variables would lead to there not being much explanatory power left at all.

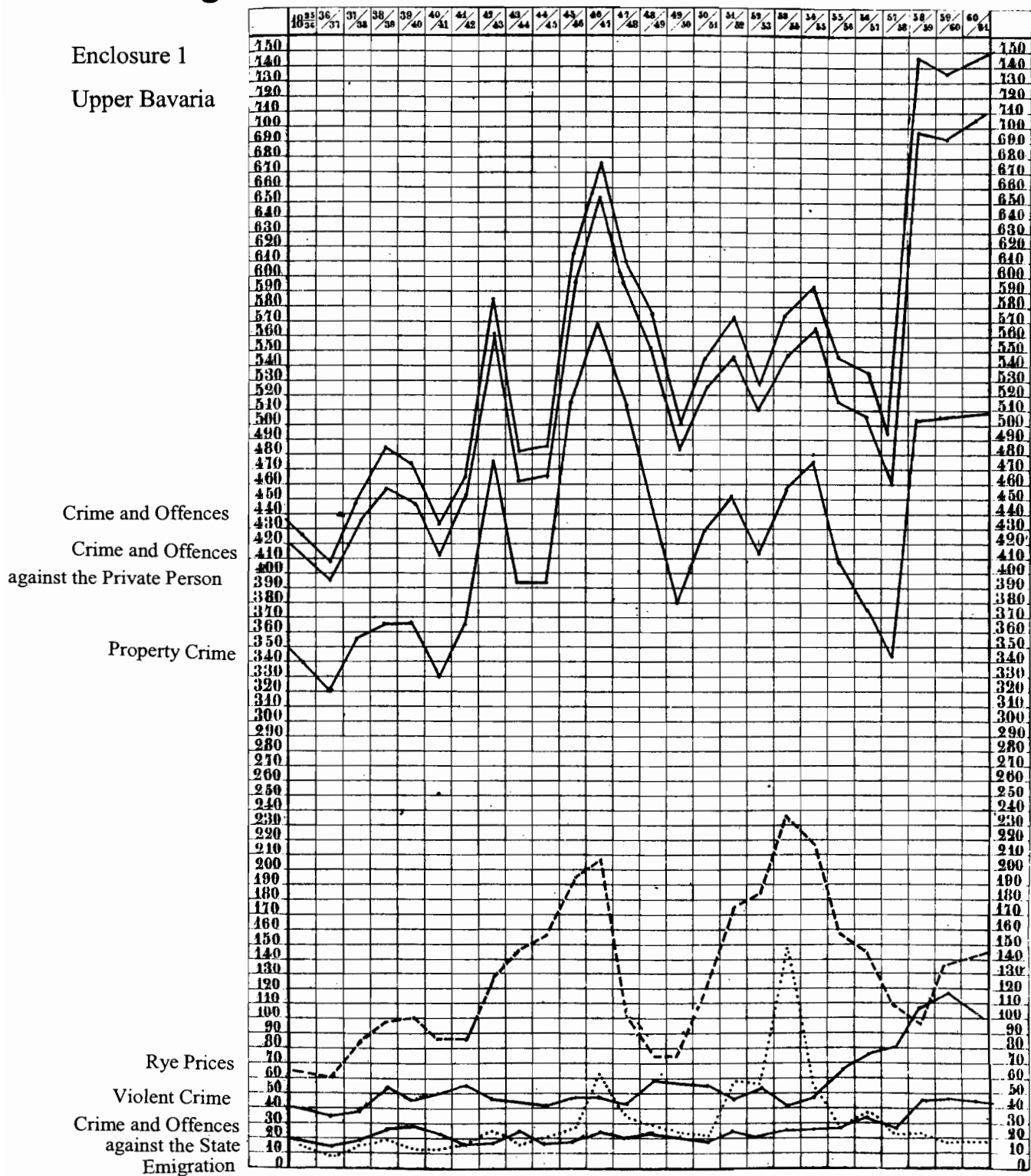
Throughout his book, I find the main problem with Mayr's way of reasoning to be that whenever he saw weak tendencies in the data he made rather strong assertions based on these tendencies. His research however still remains highly valuable, particularly so because he divided crime into different categories first and then looked at how poverty, measured in terms of rye prices, affected these different types of crime.

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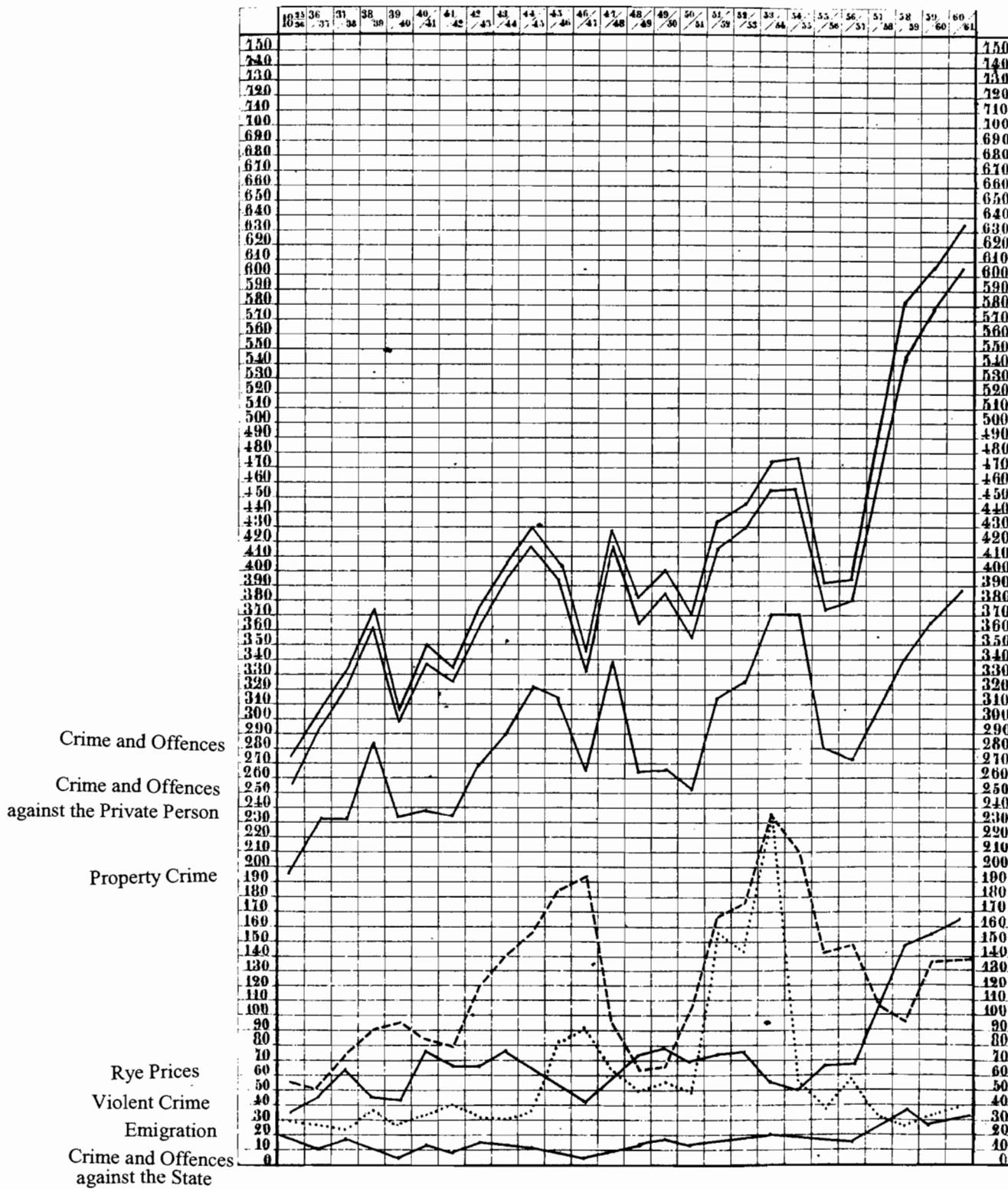
Enclosures: Fluctuations in crime, rye prices and emigration⁷⁵



⁷⁵ Georg Mayr. *Statistik der Gerichtlichen Polizei im Königreiche Bayern und in einigen anderen Ländern*. XVI. op.cit., Beilage I – VIII. [Own translation of the names on the curves.]

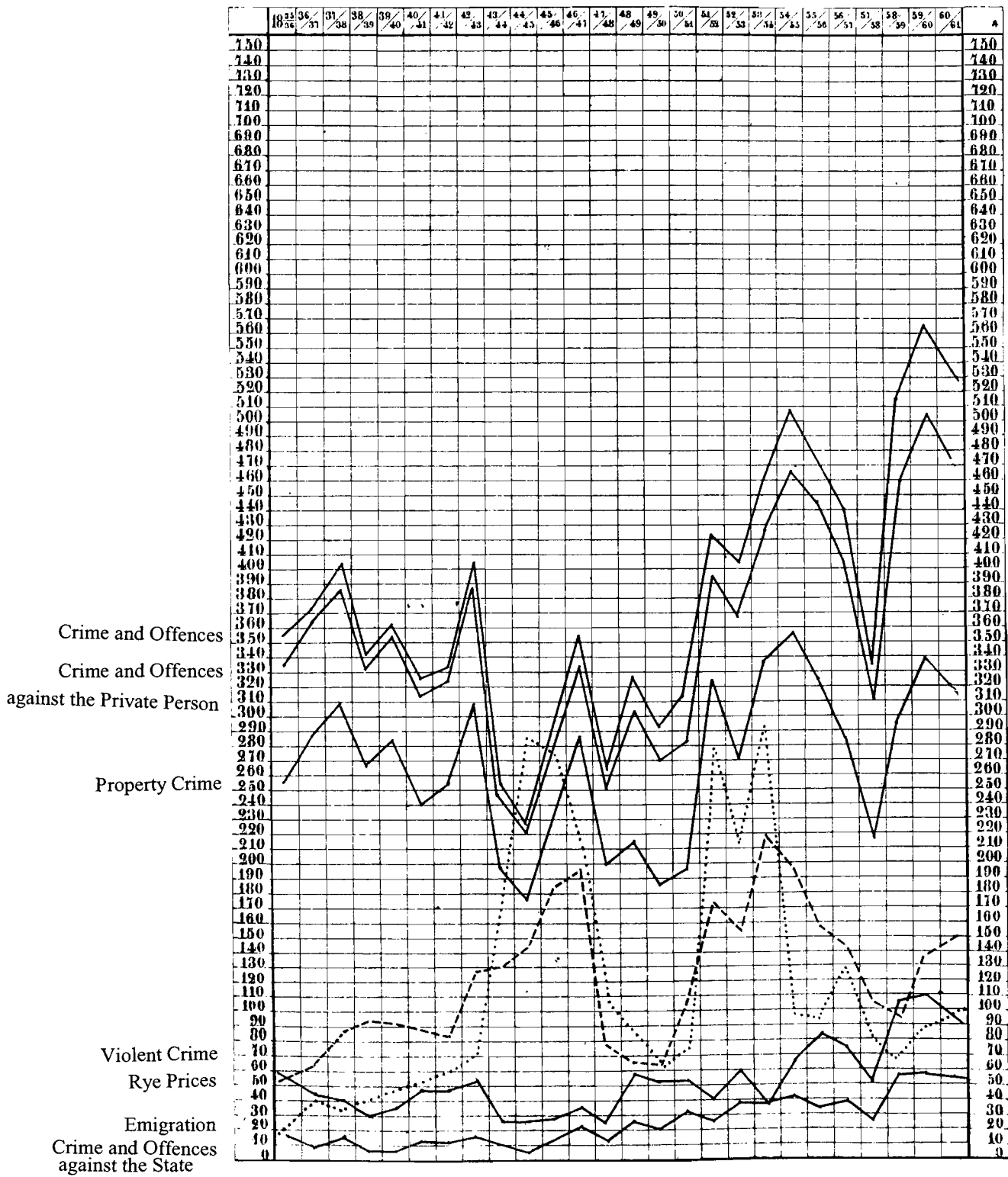
Enclosure 2

Lower Bavaria



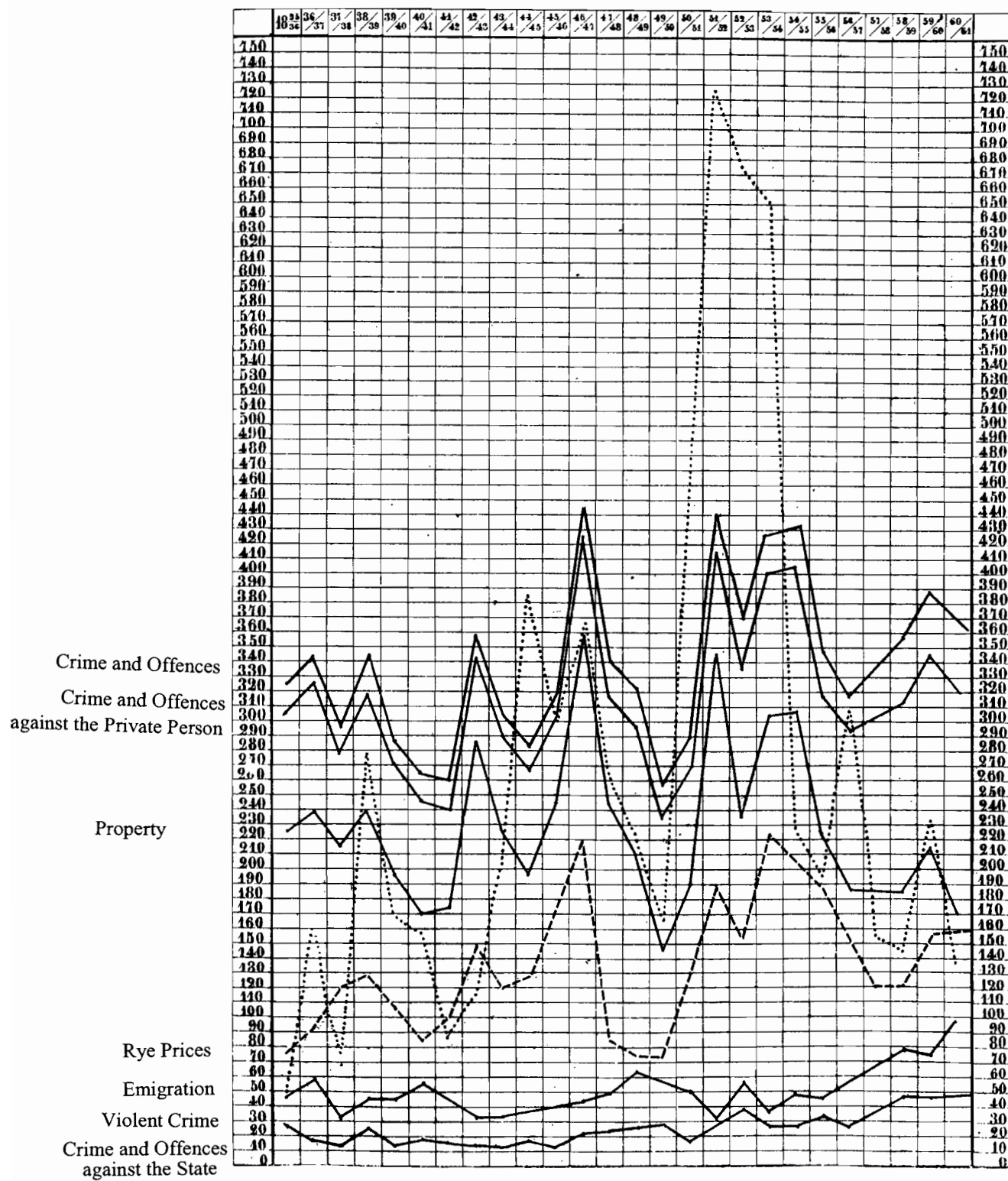
Enclosure 3

Upper Palatinate



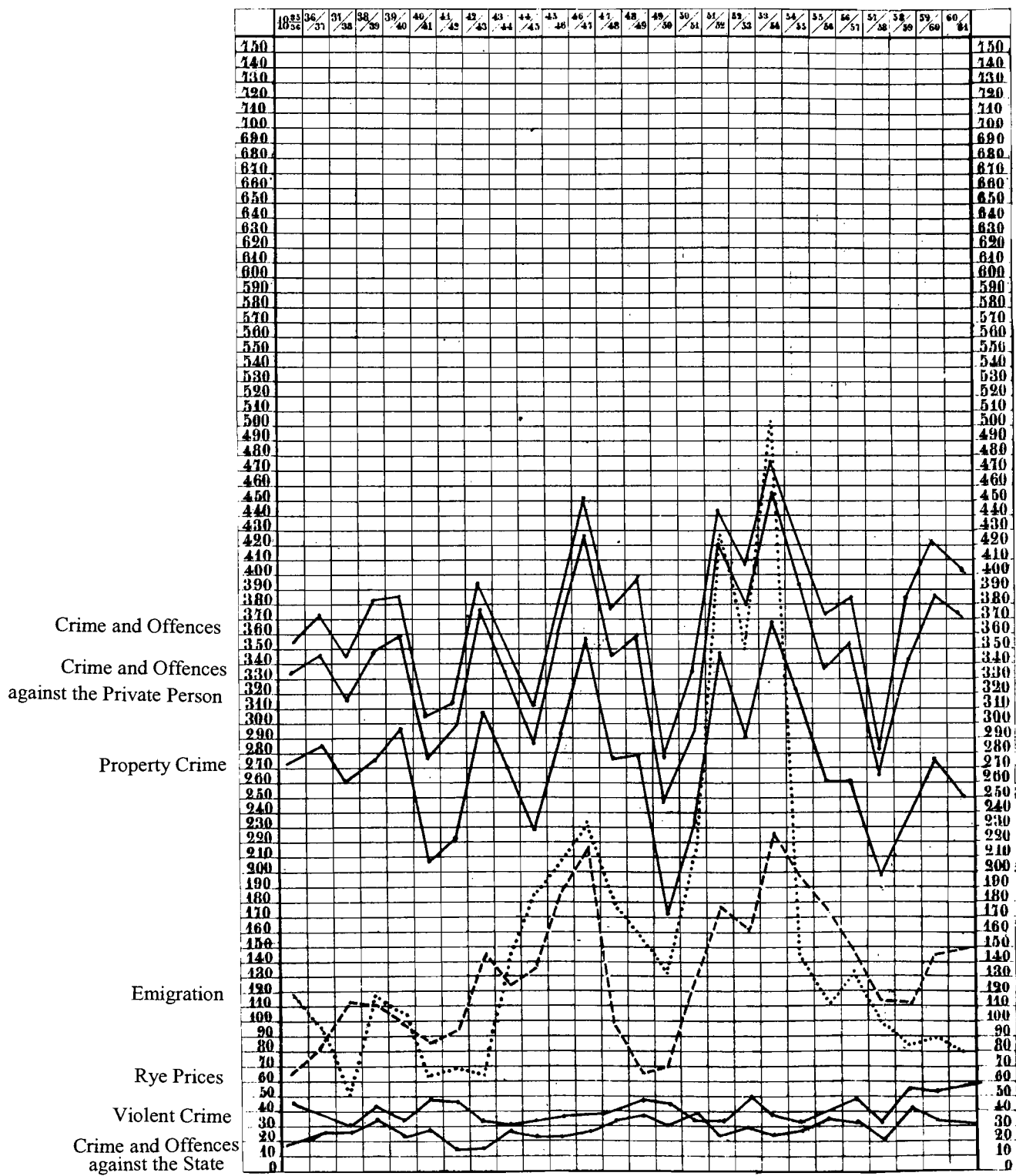
Enclosure 4

Upper Franconia



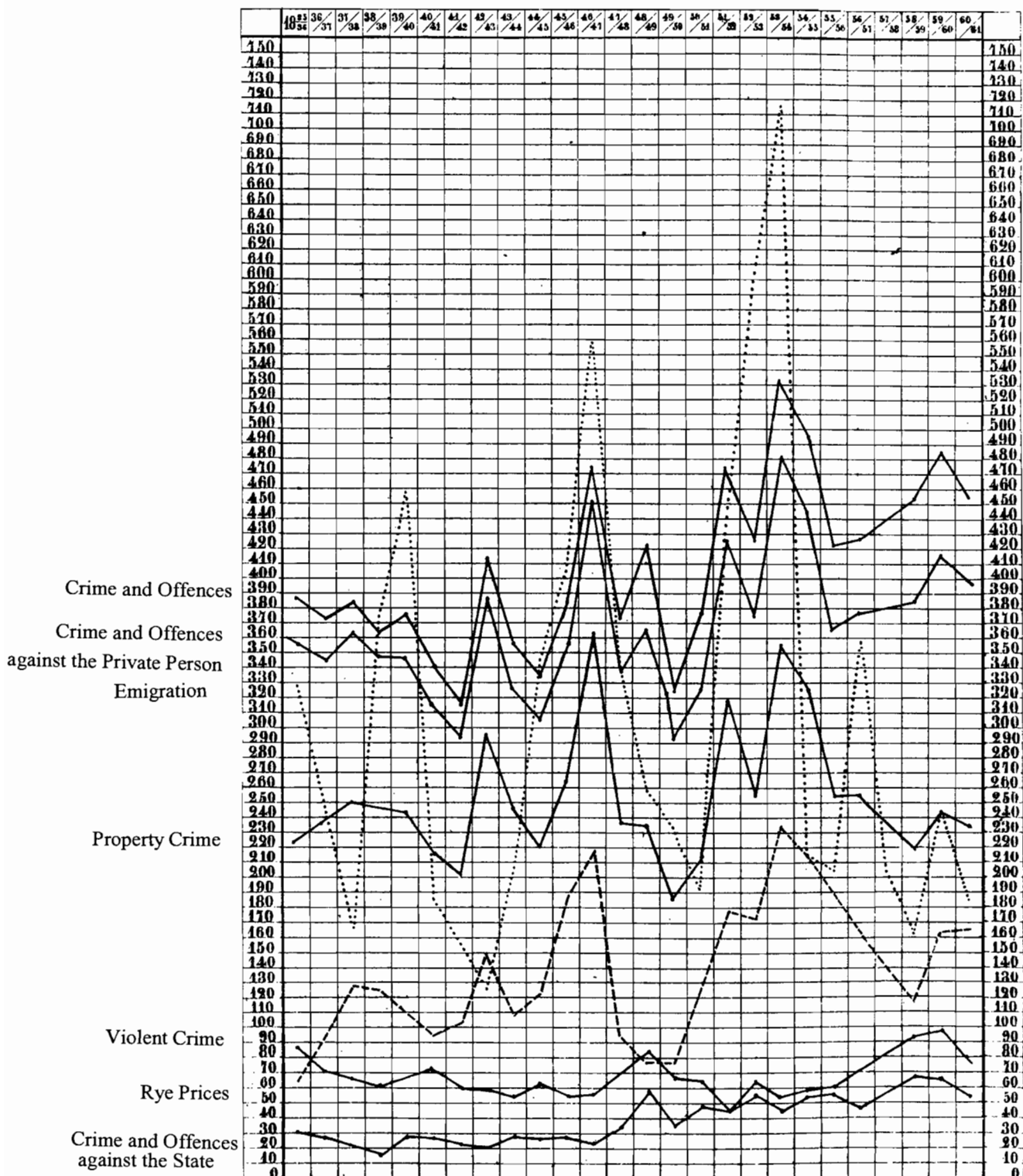
Enclosure 5

Middle Franconia



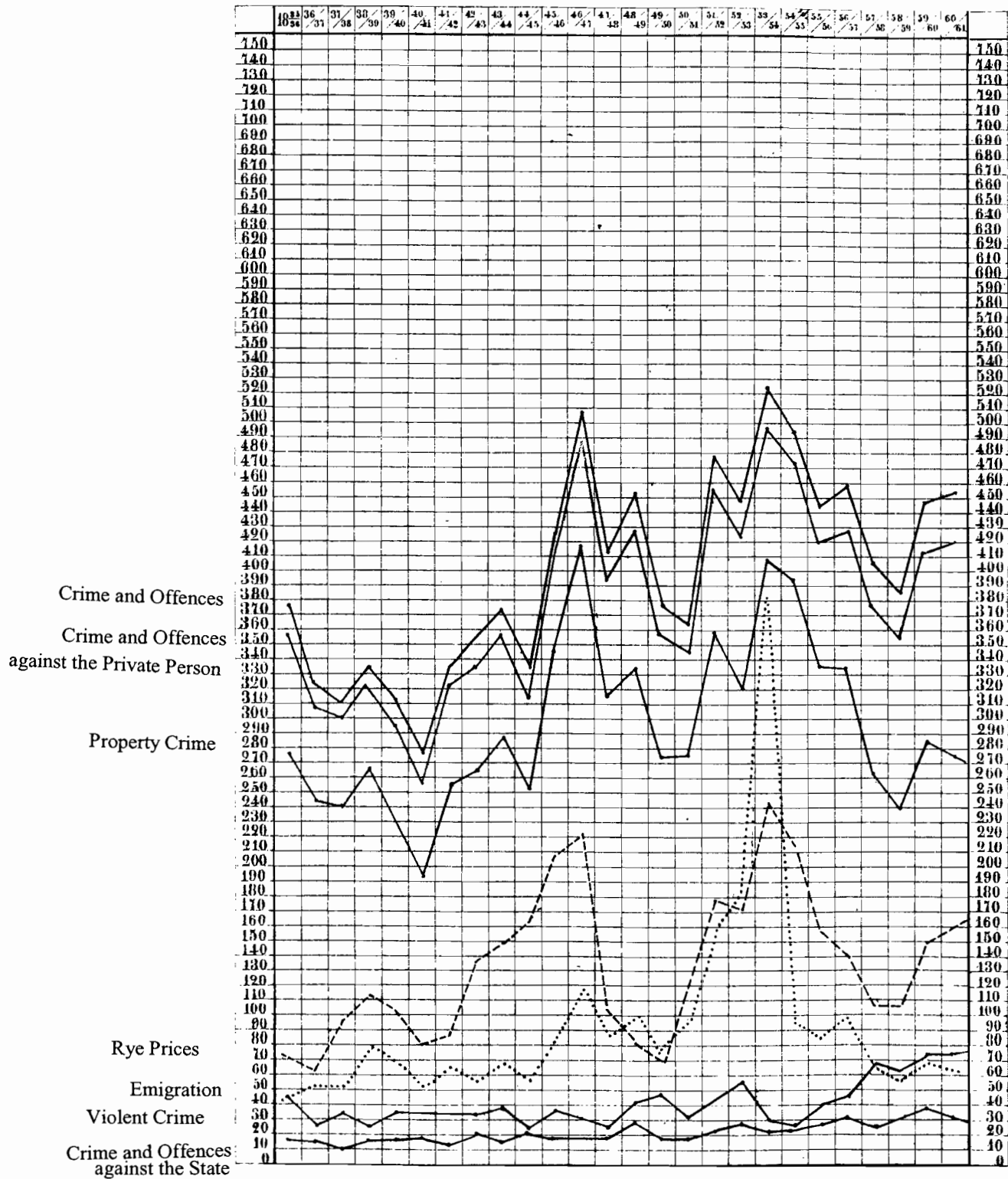
Enclosure 6

Lower Franconia



Enclosure 7

Swabia



Enclosure 8

The Kingdom of Bavaria "on this side of the Rhine" (the seven administrative regions)

